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AUTOMATIC WEATHER STATION
DEVELOPMENT AND TEST

This report is a result of work accomplished
under WARs D-171, Remote Automatic Weather Station
and D-54, GOES-DCP

by
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Bureau of Land Management
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AUTOMATIC WEATHER STATION

DEVELOPMENT AND TEST

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INTRODUCTION

BLM has a long standing requirement for rapid access to meteorological, air and water quality information from remote public lands.

In FY-77 BLM's Office of Scientific Systems Development (SSD) undertook a program to develop a portable, low power consumption automatic weather station to accomplish the rapid retrieval of remote data automatically. Two systems were assembled and successful transfer of data from remote areas was accomplished.

Ideally the weather station would adapt to any form of communication available, satellite, meteor-burst, UHF-VHF links or land line. Satellite communication was selected for the first two automatic weather stations for the following reasons:

1. Rapid, near real time return of data and the availability of the Geostationary Operational Environment Satellites (GOES) satellites. GOES satellites are operated by the National Oceanic and Atmospheric Administration/National Environmental Satellite Service (NOAA/NESS).
2. The GOES Satellites are geostationary (East or West) and one or the other is visible from nearly all public lands managed by BLM. Since most of BLM responsibility lands are located in the Western United States and Alaska, the GOES West Satellite was selected (135° W, located directly over the equator).
3. Satellite Data Collection Packages (DCPs) are readily available at a reasonable cost (\$3,150, GSA Schedule, La-Barge Electronics, Tulsa, Oklahoma).
4. One also has the choice of geostationary (GOES) or polar orbiting satellites (Landsat) with the La Barge DCP.

5. VHF-UHF links to extremely remote areas are not practical (line of sight limitations).
6. Land lines are not available in some remote areas.
7. Meteor burst communications and equipment is still in the developmental stage.
8. Data can be returned to the user in near real time using the GOES Data Collection System (DCS). Even though these first units have been tested through the GOES-DCS, they are also designed to operate through the other communication media. By blocking the systems into discreet functions, one can attach a data logger and the desired communications systems at the output of the signal conditioning unit. In the case of meteor-burst communication, one has only to change a connector to operate the station through meteor-burst communications system instead of the GOES-DCP.

SYSTEM DESCRIPTION

The BLM Automatic Weather Station consist of six basic parts:
 (1) physical structure (tripod with tundra pads and steel box),
 (2) sensors, (3) signal conditioning unit and precipitation gauge accumulating counter, (4) GOES-DCP and test set, (5) GOES antenna, and (6) power system (solar panels and batteries).

1. The tripod is designed as a free standing, high wind load structure (see Fig. 2 and Fig. 3). All structural members are 2" thick wall tubular aluminum. (Prototype tripod manufactured by Synergetics, P.O. Box E, Boulder, Colorado 80306) The structure is approximately 4.3 meters (14 ft.) to the antenna. Swiveling tundra pads are provided with holes for securing if desired. One leg is adjustable to provide for leveling. A 2' X 3' X 1.5' lockable steel enclosure (NEMA) is provided to house the electronics, patch panel, batteries and pressure sensor. One inch steel conduit shields the up-mast sensor wiring and traverses from near the top of the mast to an entry point underneath the steel chassis. The conduit is held in place along the mast and down one of the supporting legs by hose clamps. A weather head located where the cables from the sensors enter the conduit prevents excessive moisture and dust from entering.
2. The sensor specifications are as follows:
 - A. Cumulative Precipitation Gauge (w/o heater); Weather Measure Co., 0.01 in. to 99.99 in. (digital output).
 - B. Wind Speed (Met 1 Model 014 with 12 sec time constant). Sensor powered for more than 5 time constants before monitoring occurs. 0-125 mph, 1 mph Theshold, $\pm 1\%$ or 0.25 mph, 0-5v analog.

- C. Wind Direction, Met 1, Model 024 with Model 1190 card 0-548, 12 sec time constant. Sensor powered for more than 5 time constants before monitoring occurs. 0-360 degrees, 1 mph threshold, $\pm 1/2\%$ of full scale linearity, ± 5 degree accurate, scaled 0-5v analog.
 - D. Temperature, Met 1 Model 060 with directional radiation shield. Range -50 degree C. to +50 degree C., ± 0.8 degree C. linear to ± 0.15 degree C., scaled 0-5v analog.
 - E. Relative Humidity, Met 1 Model 083 with sky shield. Sensing element, thin film capacitor, range 0-100%, temp range -40 degree F. to +175 degree F. Response time 10 to 20 seconds, sensitivity--better than $\pm 3\%$, hysteresis--excursion less than $\pm 1\%$, temperature coefficient 0.07% per 1 degree C. Output scaled 0-5v analog.
 - F. Barometric Pressure, Met 1, Model 090. Resolution $\pm .15\%$, linearity $\pm .3\%$, operating temperature -30 degree F. to +180 degrees F., temperature coefficient--less than 0.0025% degrees F. Output scaled 0-5v analog.
 - G. Battery Monitor, La Barge Electronics, accuracy 0.2V from 8.9 to 15.0 volts. Output scaled 0-5v analog.
3. The signal conditioning unit consists of a power supply card rack, and input output connectors. Also included is a connector to access and test the tipping bucket rain gauge accumulating counter card.

Each sensor has a signal conditioning card located in this unit. With the exception of the tipping bucket rain gauge, all sensors on these first two stations have their outputs scaled 0-5v analog over the dynamic range of the device. For example, 0-125 mph on wind speed would be represented as a linear voltage varying from 0-5v, with 4v representing 100 mph. The rain gauge signal conditioning card accumulates tipping bucket counts. .01 inches of precipitation tips the balanced bucket in one direction and sends an event signal to the counter in the Signal Conditioning Unit which accumulates one count. The counter continues to accumulate counts to 9999 and then resets to 0000. 9999 represents 99.99 inches of precipitation. To determine accumulated precipitation over any time interval, one subtracts the initial reading from the final reading.

In the present station configuration the rain gauge is the only sensor with digital data presented to the D.C.P.

4. The DCP used is the ERTS/GOES convertible/Data Collection Platform (CDCP), manufactured by La Barge Electronics. This unit is completely microprocessor-controlled and all control

parameters are entered into the micro system by means of a test set when the station is put into operation.

The BLM station are programmed to automatically record sensor parameters every thirty minutes and transmit the data via the GOES Data Collection System every three hours. This can be varied depending upon user requirements and NOAA/NESS advices.

The DCP will accept four digital inputs and eight analog in the GOES mode giving a total sensor capability of 12.

The most important power saving design feature of the DCP is a switched 12v output that permits "putting the sensors to sleep" (remove all power) until approximately 70 seconds before the sensors are to be sampled. In essence, all the electronics involved is powered down between samples with the exception of the precipitation event counter, the DCP clock and memory. Those exceptions draw such low power that it is insignificant compared to the charging rate of the batteries. (see Table 1)

5. The La Barge GOES Antenna consists of two quadrature phased cross-element yagi antennas mounted on a common boom. The elements are cut to 400 MHz with a ± 2 MHz bandwidth. The half-power points are $\pm 23\text{-}1/2^\circ$ and the gain is 11 dbic.
6. The power system consists on two 3.5w Solarex Co. solar panels with regulators. These panels connected in parallel charge two paralleled 20 Ah Gel-Cell Batteries. The batteries are connected to the 12v input of the DCP.

COST

The cost for the station interfaced and assembled was approximately \$13,000 each. One could expect a reduction from this figure if quantities were involved. (This cost does not represent engineering and development costs incurred by BLM).

AUTOMATIC WEATHER STATION TESTS

The primary objective of the Automatic Station Tests was to determine if data from remote areas could be accurately returned to the user in near real-time. Secondary objectives are to test the GOES DCS at a high latitude (low horizon angle to the synchronous satellite), various sensor adaptability and compatibility with the BLM Station and general system configuration usefulness. Also considered was the demand for the information returned.

Table 1. CDCP Output Characteristics, GOES Mode

Description	Characteristics
Transmit Frequency	401.7 to 401.85 mHz
Channel spacing	1.5 kHz
Frequency stability, long term	1 ppm per year
Spurious outputs and harmonics	-50 db (below carrier)
Modulation	Phase shift keyed (PSK)
Phase shift magnitude	$\pm 60^\circ$ ($\pm 10^\circ$) with a transition time of 20 (± 10 microseconds)
Output bit rate	100 $\pm$.1bps, Manchester encoded
Output format	5 seconds of clear carrier, 2.56 seconds of Manchester encoded clock pulses, 15 bit maximal linear sequence (MLS) of 0100 1101 0111, 31 bit CDCP ID address up to 2000 bit data message, and Three ASCII EOT (end of transmission) pulses
Transmitter Fail Safe Feature	Transmitter will automatically power down after a 90 second transmission interval (independently of microprocessor control)
Coding	Data is encoded into eight bit bytes to ASCII format
Parity	Even or Odd (Selectable)
Message intervals	Selectable (by a constant entered from test set) from 15 minutes to 63 hours, 45 minutes (up to 255 increments) in 15 minute increments
Message interval accuracy	1 part per million (PPM) per year
Accuracy of initial transmission	$\pm$ 1 second (Controlled by operator)
Emission Classification	1.5F9/5

THE ALASKA TEST

A long standing demand for remote fire weather information from interior Alaska and the high latitude involved provided a "worst-case" test for the first automatic weather station delivered.

In discussions with BLM Fire Management, BLM contract meteorologists and the Fire Operations People in Alaska, it was mutually decided to test system #1 North of the Eagle-Chicken area in Eastern Alaska.

In that area of Alaska there is an oil exploration airstrip located on native corporation land. Through BLM Fire Management, permission was granted to install the station by the native corporation. On the 28th of July, the BLM automatic weather station was installed at the Salmon-Trout Airstrip located at approximate geographic coordinates 67°N, 141° 30'W. A one day delay in transmitting was due to a faulty indication on the test set. On the 29th, the first data was returned via the NWS network in Anchorage and Fairbanks. On 5 August 1977, the data was fed to the BLM Fire Weather Teletype (TTY) drop and arrived in the BLM forecasting office in near real-time. As an added test "bonus", a fire (#8945, 1,350 acres) ignited within a mile of the Automatic Station and BLM Forecasters were able to generate spot forecasts on the basis of the data received. The station was pulled out of Salmon-Trout near the end of the Alaska fire season on 9 Sept. 77.

All sensors worked properly for the duration of the test. There was some question about the relative humidity sensor. Under certain meteorological conditions, the relative humidity would go over 100%. It appears that this over range occurs in fog under low cloud conditions. This is consistent with the Analog to Digital conversion within the DCP. Actually, an absolute 0 volts is digitized as "00000000" and 4.98 volts is represented by the binary number "11111111". The voltage just beyond 4.98 Volts starts over at "00000000" but cannot be interpreted accurately. What it indicates is a super saturated moisture condition in the case of relative humidity.

The tipping bucket accumulating counter was preset to 0100 indicating 100/100 inches of precipitation. This prevented transmitting all zeros before measurable precipitation occurred.

IDAHO TEST

The second of two platforms was assembled and tested in Grassmere, Idaho, about 120 miles South, South East of Boise, at approximately 42°20' Lat., 115°52' Long.

On September 6, 1977, eleven packages (420 lbs.) arrived at the Boise Interagency Fire Center. After an inventory on September 7,

seven people proceeded by truck to Grassmere. Installation began at 13:30 hrs local and was completed by 17:30.

Some small problems were encountered when it was discovered that some set screws and large bolts for the tripod were missing. Another problem that was encountered was the Thunder Scientific Sensor for relative humidity and temperature had to be modified to adapt to mounting on the tripod. After mounting, it was found to be defective, and as of present date, we have no readings on temperature and relative humidity.

When the DCP was programed, the start time was entered incorrectly; and, consequently, it was transmitting two minutes early. This has now been corrected by simply reprogramming the timing circuit.

Through the experiences it was found helpful to bring along some special equipment to assist in the installation. A small portable generator is convenient to power some hand tools like a drill or soldering iron. A surveyor's transit is good for aligning the antenna, wind direction and leveling the structure. A WWV receiver is necessary to calibrate the timing network to insure the accuracy of the transmitting time.

Weather Station #1 was mechanically assembled at the BLM Fairbanks Fire Center prior to installation at Salmon-Trout. Station #2 was taken directly to Grassmere. It is essential that future stations be assembled prior to installation to insure hardware, connector, wiring and system components are in order.

DATA RECOVERY

All weather data obtained by the "Automatic Remote Weather Station" is transmitted via GOES uplink to the Geostationary Operational Environmental Satellite located at 135 degrees west (GOES west). The data is then retransmitted to a command and data acquisition ground station located at Wallops Island, Virginia. From this point through leased lines the data is transfered to a computer at the World Weather Building (WWB), Campsprings, Maryland. The WWB computer is the point of dissemination of all information to the users.³

A properly identified user may access the information by the direct dial in method in the real time mode. Two seperate extensions are used determined by the speed of the users terminal (110 or 1200 BAUD).

Another method that may be used to access the information that is currently being used by the state of Alaska is to go through one or a series of computers. For example, the National Weather Service (NWS) requested the weather data be transfered from the NOAA/NESS data file to the FAA computer at Kansas City, Missouri. From there

it is transferred to the Weather Service Teletype System that is directly tied into Anchorage and Fairbanks. By this second method it takes less than six minutes from time of platform transmission to the time it appears on the teletype in Alaska.

The data on the terminal or teletype arrives in the American Standard Code for Information Interchange and needs to be converted to hexadecimal before the following charts can be utilized to determine meteorological parameters.

STANDARD CODE	HEXADECIMAL
	0
A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9
J	A
K	B
L	C
M	D
N	E
O	F

One of our GOES data collection platforms has the I.D. number of 16CE74D4, and a printout of data on this station is as follows: the data was received on the NWS teletype system on July 30, 1977, shortly after 2051 GMT.

The first line is NWS information. The second line starts with the DCP I.D. 16CE74D4. The next nine characters are the date and time group (e.g., 211 = day of the year, 2051 = data transfer time from the DCP).

The Tipping Bucket Rain Gauge (four character) data is displayed above as 00A0 in all six blocks of data. To translate--one first inverts this data to 0A00 and then converts to Hexadecimal to yield 0100 or 100/100 inches (or one inch) of precipitation. This is the value set into the platform on initialization and indicates that there has been no measurable precipitation since. If 2/100 inches of rain should occur before the next transmission, the next data readout would be BOA0, inverted to 0A0B and translated to 0102 or 102/100 inches.

The next two characters represent the wind speed read-out and are IA. Again, this has to be inverted to yield AI and then converted

to the Hexadecimal value of 19. The Hexadecimal value of 19 on the Wind Speed Conversion Chart is a wind speed of 9.9 mph.

This same process is then repeated for wind direction, temperature, relative humidity, barometric pressure, battery voltage and a repeat of wind direction.

One then starts again with the OOA0 reading for the rain gauge, etc.

The six sets of data represent data taken every 30 minutes for three hours with the oldest data appearing first. The first set of data is for sample time 1821Z, the second for 1851Z, etc. An attached chart shows the data converted to Meteorological Units. (see Table 2)

The wind direction sensor is sampled near the beginning and at the end of the sensor scanning operation. Since this sensor uses a 0-540 degree potentiometer, there is a finite possibility that the wind will be from a direction near the crossover point on the potentiometer. Since the wind direction is integrated over a one minute period, this crossover point could introduce direction errors. To get around this, the sensor is sampled twice approximately 12 seconds apart and if there is rough agreement between the two readings, no crossover errors have been introduced and the directions are good.

ADAPTABILITY TO OTHER COMMUNICATIONS MEDIA

The BLM Automatic Weather Station is adaptable to various forms of communication. Because of the modular design concept, the Sensor, Tripod and Signal conditioning package could remain the same regardless of the communication media involved. Externally, the station would look the same if other communications were used with the exception of the antenna and other sensor requirements (i.e., water quality, air quality, etc.). Internally the power system (batteries) and Signal Conditioning Unit would remain the same. Using the meteor-burst communications system would only require replacing the DCP with the meteor-burst unit and antenna. To interface to a VHF, UHF or micro-wave system would require an extra electronics unit between the Signal Conditioning Unit and the transmitter that would consist of a clock, data logger with analog to digital converter, scanner and modulation unit. This would be a unit identical to the DCP but with either a different transmitter or a feed to an external transmitting system.

In designing the existing weather stations, consideration was given to the data output levels and format so that interchangeability between various communications systems could be effected with minimal effort. Coordination with the Forest Service, BLM Meteor-Burst Development and the National Weather Service insured continuity in voltage levels and interchangeability of components between systems.

Table 2

	<u>Wind Speed</u>	<u>Wind Direction</u>	<u>Temperature</u>	<u>Relative Humidity</u>	<u>Barometric Pressure</u>	<u>Battery Voltage</u>	<u>Wind Direction</u>
7/30/7							
0100*	19	16	AB	74	83	42	17
1821Z	9.9	46.4	16.7	45.7	27.58	12.8	48.5
0100*	17	18	B0	68	83	42	18
1851Z	9.2	50.6	18.7	42.1	27.58	12.8	50.6
0100*	10	1C	B5	58	83	42	1D
1921Z	6.4	59.0	20.7	34.7	27.58	12.8	61.1
0100*	18	22	BC	49	84	44	22
1951Z	9.6	71.7	23.4	28.5	27.60	13.2	71.7
0100*	19	33	C0	38	85	45	33
2021Z	9.9	107.5	25.0	21.8	27.63	13.4	107.5
0100*	19	24	C0	37	85	46	24
2051Z	9.9	75.9	25.0	21.4	27.63	13.0	75.9

*0100 indicates 100/100 or 1.00 inches of precipitation

This allows each developer an opportunity to take advantage of advances made by the others and insures a quality product for a reasonable cost.

FUTURE SYSTEM DEVELOPMENT

Long term testing of the existing systems will continue over the next year.

Development of an accurate wildfire fuel moisture measuring device that will integrate into the Automatic Station has top priority.

To round out the weather station, an input solar radiation sensor should be added. These sensors and signal conditioning cards are available commercially and represent no technical problems.

Other sensors that need to be investigated are water quality, air quality and hydrology. The limiting factors are:

1. Sensor power consumption.
2. Channel capacity (eight analog and four digital).

Most of the sensors were selected on the basis of long term successful field operation, low power consumption and relatively small size. On Station #1 all the sensors met these requirements. On Station #2 a relative humidity sensor that is advertized as having superior specification but not having field testing was installed. Since this sensor also contains the temperature sensing element, these two sensors are different than Station #1.

Much valuable advice, assistance, and time was given by U.S. Forest Service, Riverside, California, and National Weather Service, Anchorage, Alaska. BIFC communications provided excellent technical support for the Grasmere test. Fire Management Alaska and the BLM Alaska Communications Group contributed greatly to the success of the Alaska test.

The electronic communications staff, DSC, aptly handled the frequency coordination and greatly aided in direct-dial data recovery.

La-Barge, Inc., Tulsa, Oklahoma collected the sensors, tripod and associated hardware as well as developed the Signal Conditioning Unit. They then integrated the components into a turn-key system complete with the La-Barge GOES-DCP. Synergetics of Boulder, Colorado solved the tripod fabrication problems and manufactured the station tripods.

REFERENCES

1. The NOAA Operational Environmental Satellite System Status and Plans, George H. Ludwig, NOAA/NESS, Washington, D.C. 20233. Presented at the 6th Conference on Aerospace & Aeronautical Meteorology, November 12-15, 1974, El Paso, Texas. Published by Amer. Meteor. Soc., Boston, MA.
2. Instruction Manual for Convertible Data Collection Platform (CDCP) and Related Equipment, by La-Barge, Inc., Tulsa, Oklahoma, April, 1976.
3. User Interface Manual, prepared for NOAA/NESS by GTE Information Systems, Silver Springs, Maryland, November 5, 1976.

APPENDIX



Fig. 1. Schematic Diagram of Weather Station

CHAPTER 1

The first chapter of the book is devoted to the study of the properties of the function $f(x)$ defined by the equation $f(x) = x^2 + 1$. The function is defined for all real numbers x and is continuous on the entire real line. The function is also differentiable on the entire real line and its derivative is $f'(x) = 2x$.

The function $f(x)$ is a parabola opening upwards with its vertex at the origin $(0, 1)$. The function is symmetric with respect to the y-axis.

The function $f(x)$ is strictly increasing on the interval $(0, \infty)$ and strictly decreasing on the interval $(-\infty, 0)$.

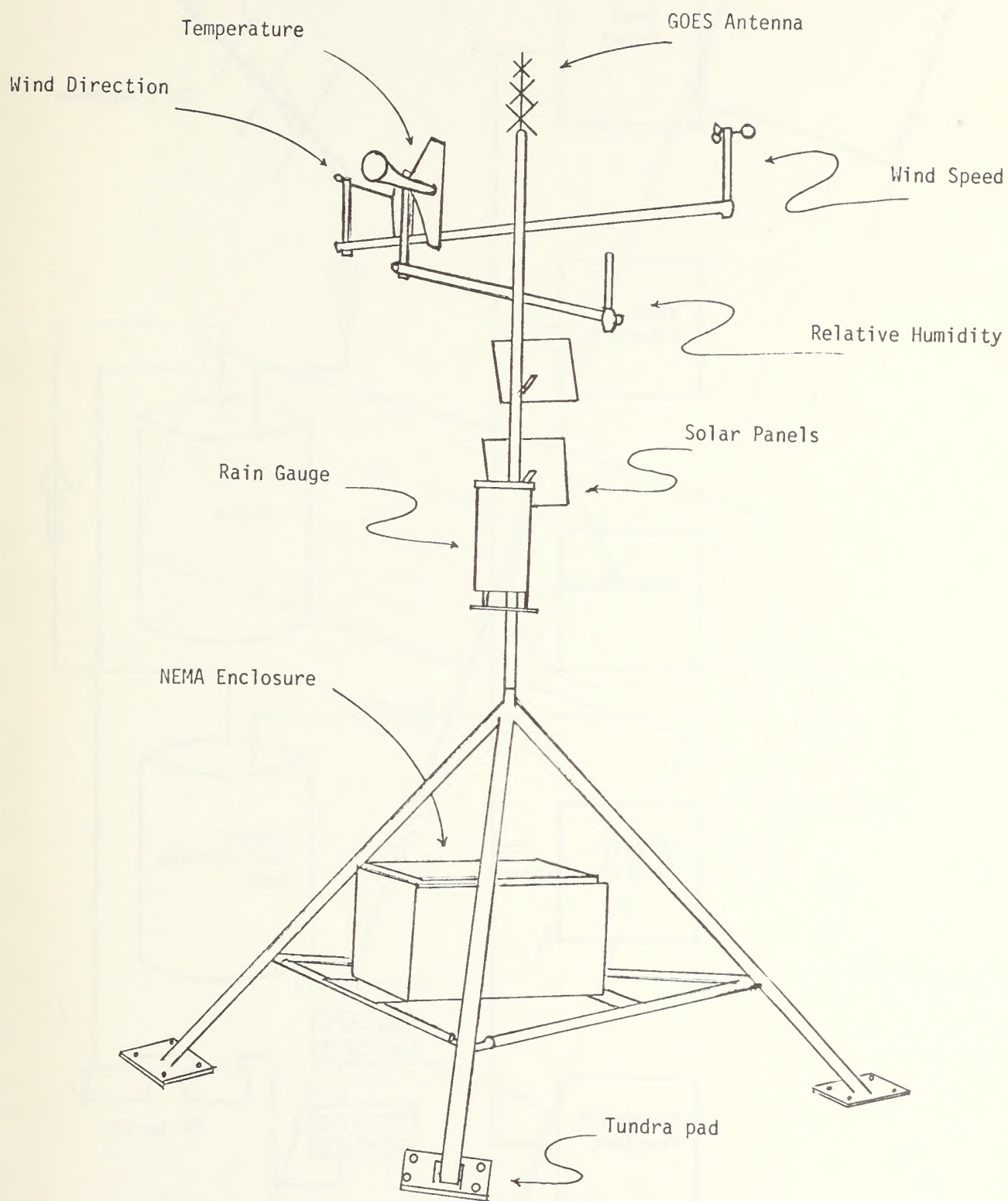


Fig. 1 BLM Automatic Weather Station

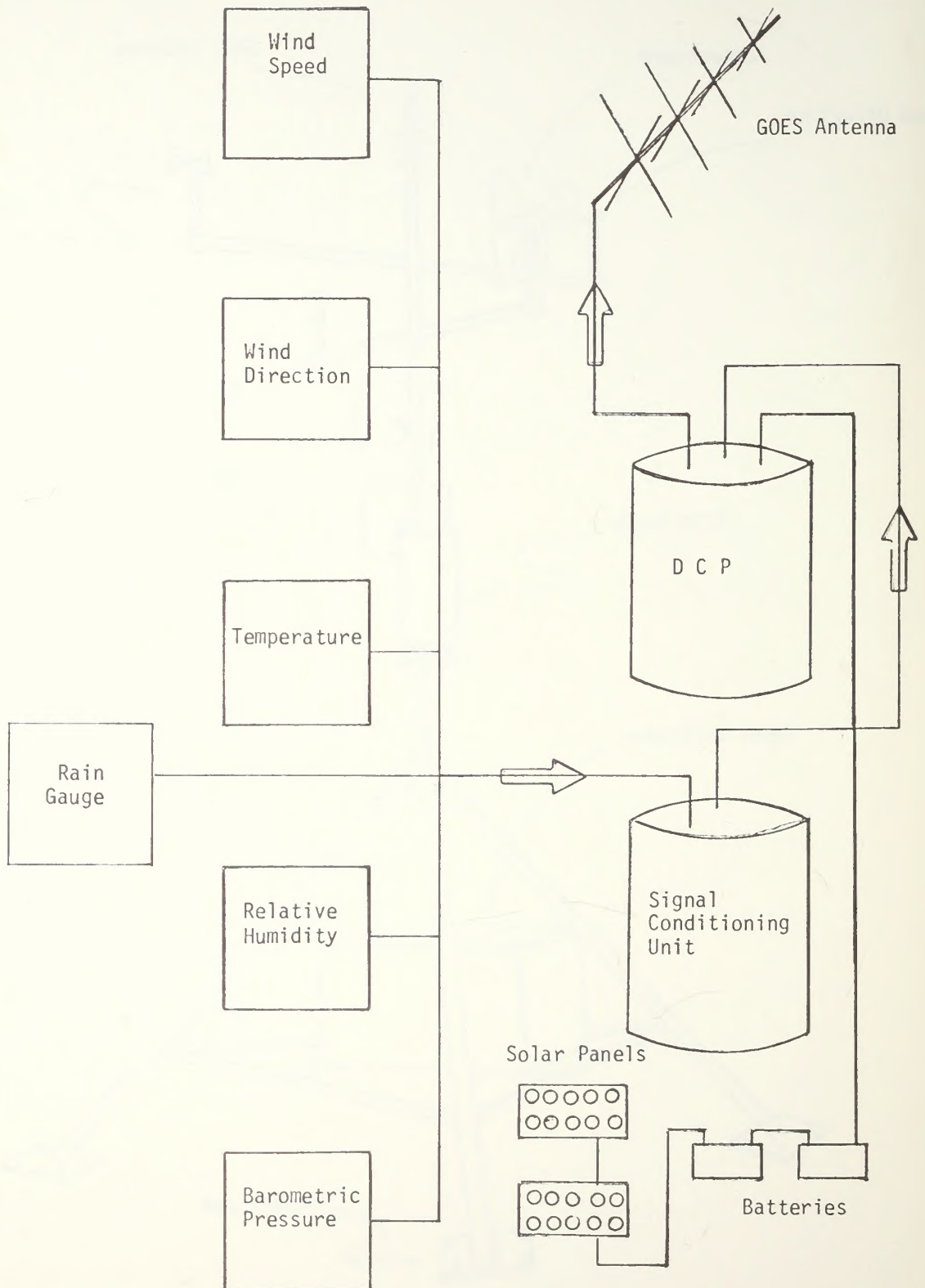


Fig. 2 Block Diagram of BLM Automatic Weather Station Model 1

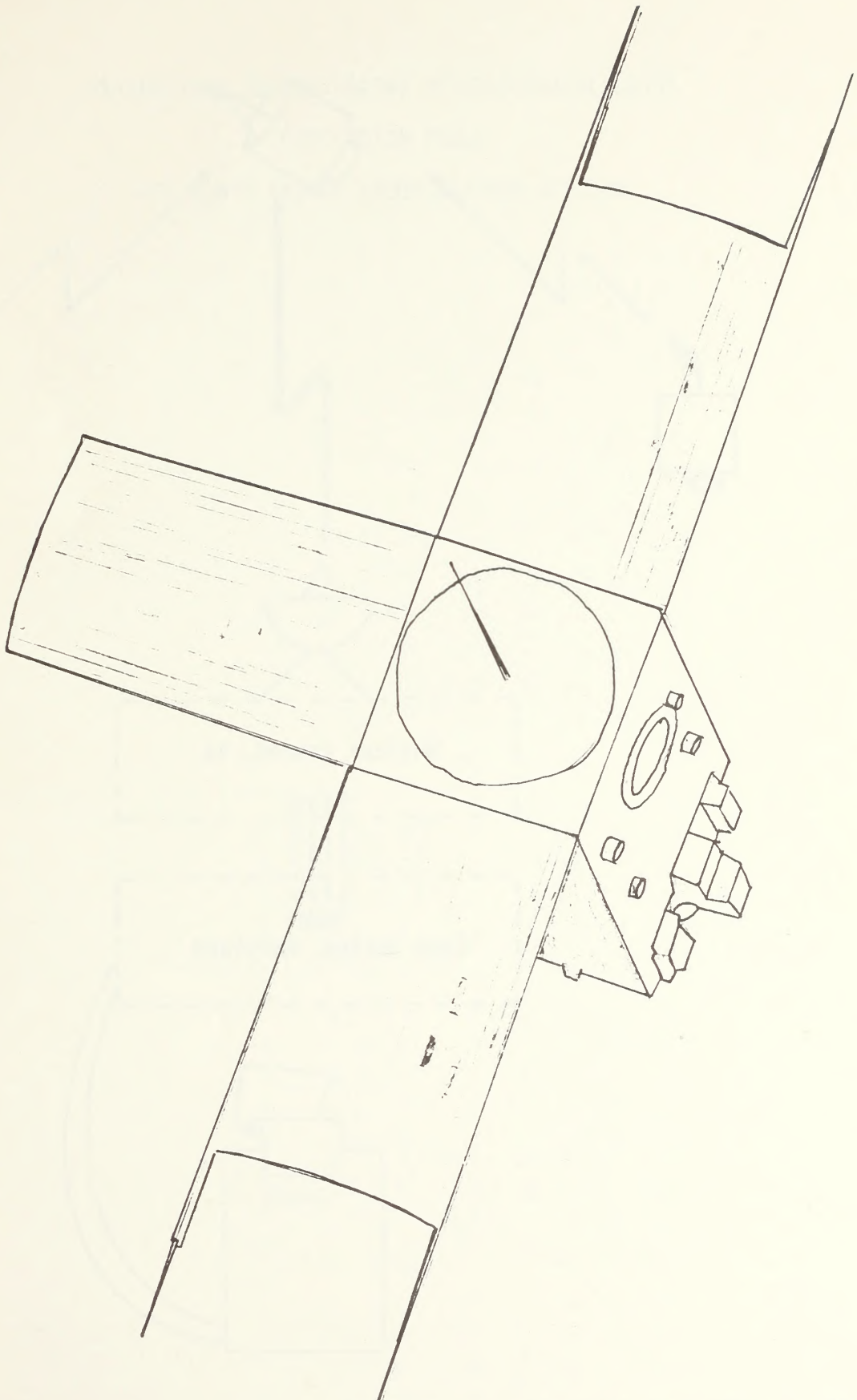


Fig. 3 GOES West Satellite

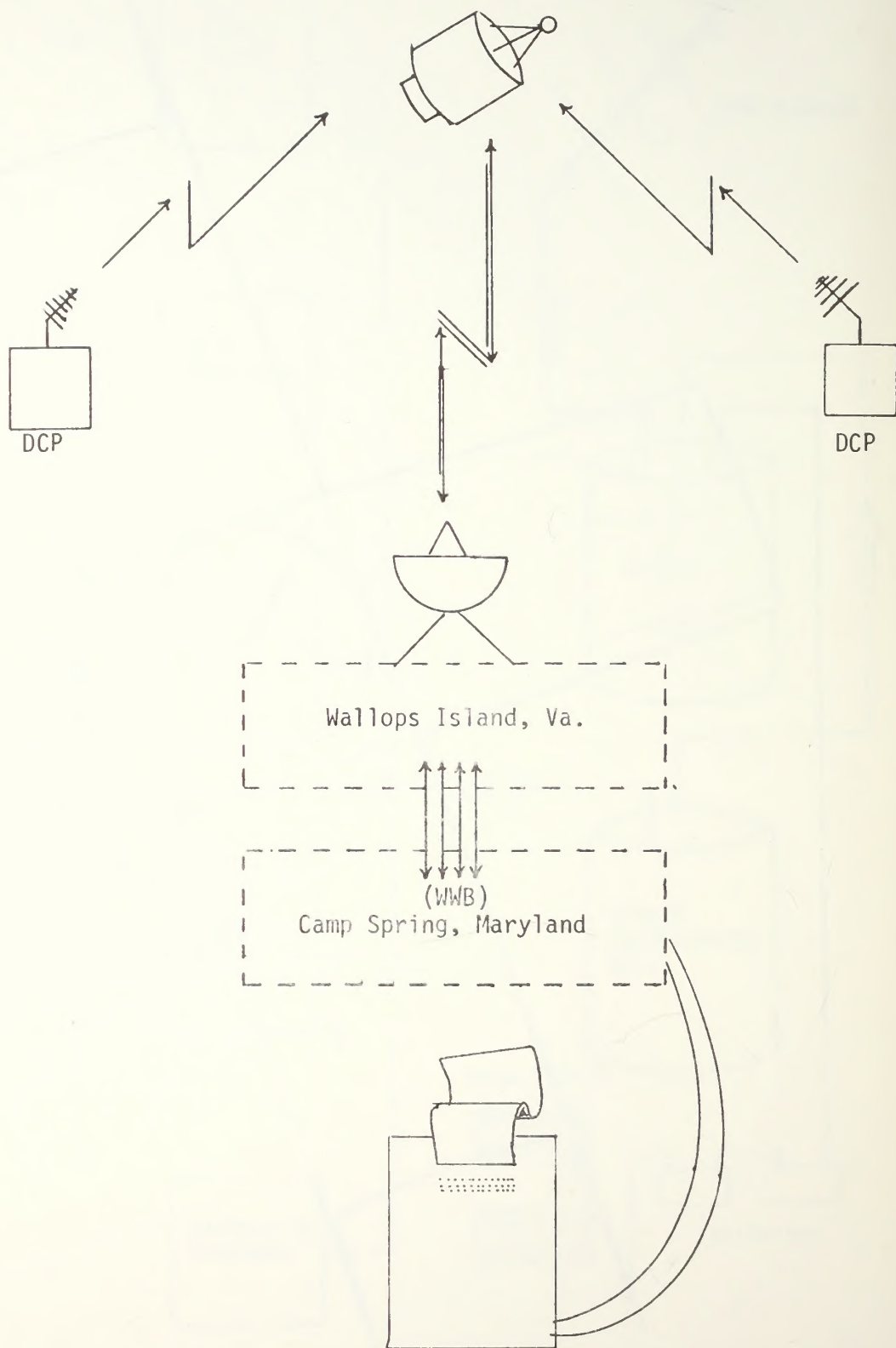


Fig. 4 GOES Data Collection System (DCS)

HEXIDECIMAL TO EQUIVALENT METEOROLOGICAL UNITS

CONVERSION TABLE

FOR BLM'S SALMON-TROUT WEATHER STATION

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 ry Location
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WIND SPEED AUG 4 1977

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT
 WIND SPEED (MPH)

reshold

HEX	MPH	HEX	MPH	HEX	MPH	HEX	MPH
00		20	12.7	40	25.2	60	37.7
01		21	13.1	41	25.6	61	38.1
02		22	13.5	42	26.0	62	38.5
03	1.4	23	13.9	43	26.4	63	38.9
04	1.7	24	14.2	44	26.8	64	39.3
05	2.1	25	14.6	45	27.1	65	39.7
06	2.5	26	15.0	46	27.5	66	40.1
07	2.9	27	15.4	47	27.9	67	40.4
08	3.3	28	15.8	48	28.3	68	40.8
09	3.7	29	16.2	49	28.7	69	41.2
0A	4.1	2A	16.6	4A	29.1	6A	41.6
0B	4.5	2B	17.0	4B	29.5	6B	42.0
0C	4.9	2C	17.4	4C	29.9	6C	42.4
0D	5.3	2D	17.8	4D	30.3	6D	42.8
0E	5.6	2E	18.2	4E	30.7	6E	43.2
0F	6.1	2F	18.5	4F	31.1	6F	43.6
10	6.4	30	18.9	50	31.4	70	44.0
11	6.8	31	19.3	51	31.8	71	44.4
12	7.2	32	19.7	52	32.2	72	44.8
13	7.6	33	20.1	53	32.6	73	45.2
14	8.0	34	20.5	54	33.0	74	45.6
15	8.4	35	20.9	55	33.4	75	45.9
16	8.8	36	21.3	56	33.8	76	46.3
17	9.2	37	21.7	57	34.2	77	46.7
18	9.6	38	22.1	58	34.6	78	47.1
19	9.9	39	22.5	59	35.0	79	47.5
1A	10.3	3A	22.8	5A	35.4	7A	47.9
1B	10.7	3B	23.2	5B	35.7	7B	48.3
1C	11.1	3C	23.6	5C	36.1	7C	48.7
1D	11.5	3D	24.0	5D	36.5	7D	49.1
1E	11.9	3E	24.4	5E	36.9	7E	49.5
1F	12.3	3F	24.8	5F	37.3	7F	49.9

☐
 Dry Location
 t ☐ 2nd ☐
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WIND SPEED
 DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT
 WIND SPEED (MPH)

HEX	MPH	HEX	MPH	HEX	MPH	HEX	MPH
80	50.3	A0	62.9	C0	75.5	E0	88.1
81	50.7	A1	63.3	C1	75.9	E1	88.5
82	51.1	A2	63.7	C2	76.3	E2	88.9
83	51.5	A3	64.1	C3	76.7	E3	89.3
84	51.9	A4	64.5	C4	77.1	E4	89.7
85	52.3	A5	64.9	C5	77.5	E5	90.1
86	52.6	A6	65.3	C6	77.9	E6	90.5
87	53.0	A7	65.6	C7	78.3	E7	90.9
88	53.4	A8	66.0	C8	78.7	E8	91.3
89	53.8	A9	66.4	C9	79.0	E9	91.7
8A	54.2	AA	66.8	CA	79.4	EA	92.0
8B	54.6	AB	67.2	CB	79.8	EB	92.4
8C	55.0	AC	67.6	CC	80.2	EC	92.8
8D	55.4	AD	68.0	CD	80.6	ED	93.2
8E	55.8	AE	68.4	CE	81.0	EE	93.6
8F	56.2	AF	68.8	CF	81.4	EF	94.0
90	56.6	B0	69.2	D0	81.8	F0	94.4
91	57.0	B1	69.6	D1	82.2	F1	94.8
92	57.4	B2	70.0	D2	82.6	F2	95.2
93	57.8	B3	70.4	D3	83.0	F3	95.6
94	58.2	B4	70.8	D4	83.4	F4	96.0
95	58.6	B5	71.2	D5	83.8	F5	96.4
96	59.0	B6	71.6	D6	84.2	F6	96.8
97	59.3	B7	72.0	D7	84.6	F7	97.2
98	59.7	B8	72.3	D8	85.0	F8	97.6
99	60.1	B9	72.7	D9	85.3	F9	98.0
9A	60.5	BA	73.1	DA	85.7	FA	98.4
9B	60.9	BB	73.5	DB	86.1	FB	98.7
9C	61.3	BC	73.9	DC	86.5	FC	99.1
9D	61.7	BD	74.3	DD	86.9	FD	99.5
9E	62.1	BE	74.7	DE	87.3	FE	99.9
9F	62.5	BF	75.1	DF	87.7	FF	100.3

A/D# WIND DIRECTION

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT

 ry Location
 Digit 2nd Digit

WIND DIRECTION (DEGREES)

(See Attached Figure)

HEX	Degrees
00	0.0
01	2.1
02	4.2
03	6.3
04	8.4
05	10.5
06	12.6
07	14.7
08	16.8
09	18.9
0A	21.0
0B	23.2
0C	25.3
0D	27.4
0E	29.5
0F	31.6
10	33.7
11	35.8
12	37.9
13	40.0
14	42.1
15	44.2
16	46.4
17	48.5
18	50.6
19	52.7
1A	54.8
1B	56.9
1C	59.0
1D	61.1
1E	63.2
1F	65.3

HEX	Degrees
20	67.5
21	69.6
22	71.7
23	73.8
24	75.9
25	78.0
26	80.1
27	82.2
28	84.3
29	86.4
2A	88.5
2B	90.7
2C	92.8
2D	94.9
2E	97.0
2F	99.1
30	101.2
31	103.3
32	105.4
33	107.5
34	109.6
35	111.7
36	113.9
37	116.0
38	118.1
39	120.2
3A	122.3
3B	124.4
3C	126.5
3D	128.6
3E	130.7
3F	132.8

HEX	Degrees
40	135.0
41	137.1
42	139.2
43	141.3
44	143.4
45	145.5
46	147.6
47	149.7
48	151.8
49	153.9
4A	156.0
4B	158.2
4C	160.3
4D	162.4
4E	164.5
4F	166.6
50	168.7
51	170.8
52	172.9
53	175.0
54	177.1
55	179.2
56	181.4
57	183.5
58	185.6
59	187.7
5A	189.8
5B	191.9
5C	194.0
5D	196.1
5E	198.2
5F	200.3

HEX	Degrees
60	202.5
61	204.6
62	206.7
63	208.8
64	210.9
65	213.0
66	215.1
67	217.2
68	219.3
69	221.4
6A	223.5
6B	225.7
6C	227.8
6D	229.9
6E	232.0
6F	234.1
70	236.2
71	238.3
72	240.4
73	242.5
74	244.6
75	246.7
76	248.9
77	251.0
78	253.1
79	255.2
7A	257.3
7B	259.4
7C	261.5
7D	263.6
7E	265.7
7F	267.8

WIND DIRECTION

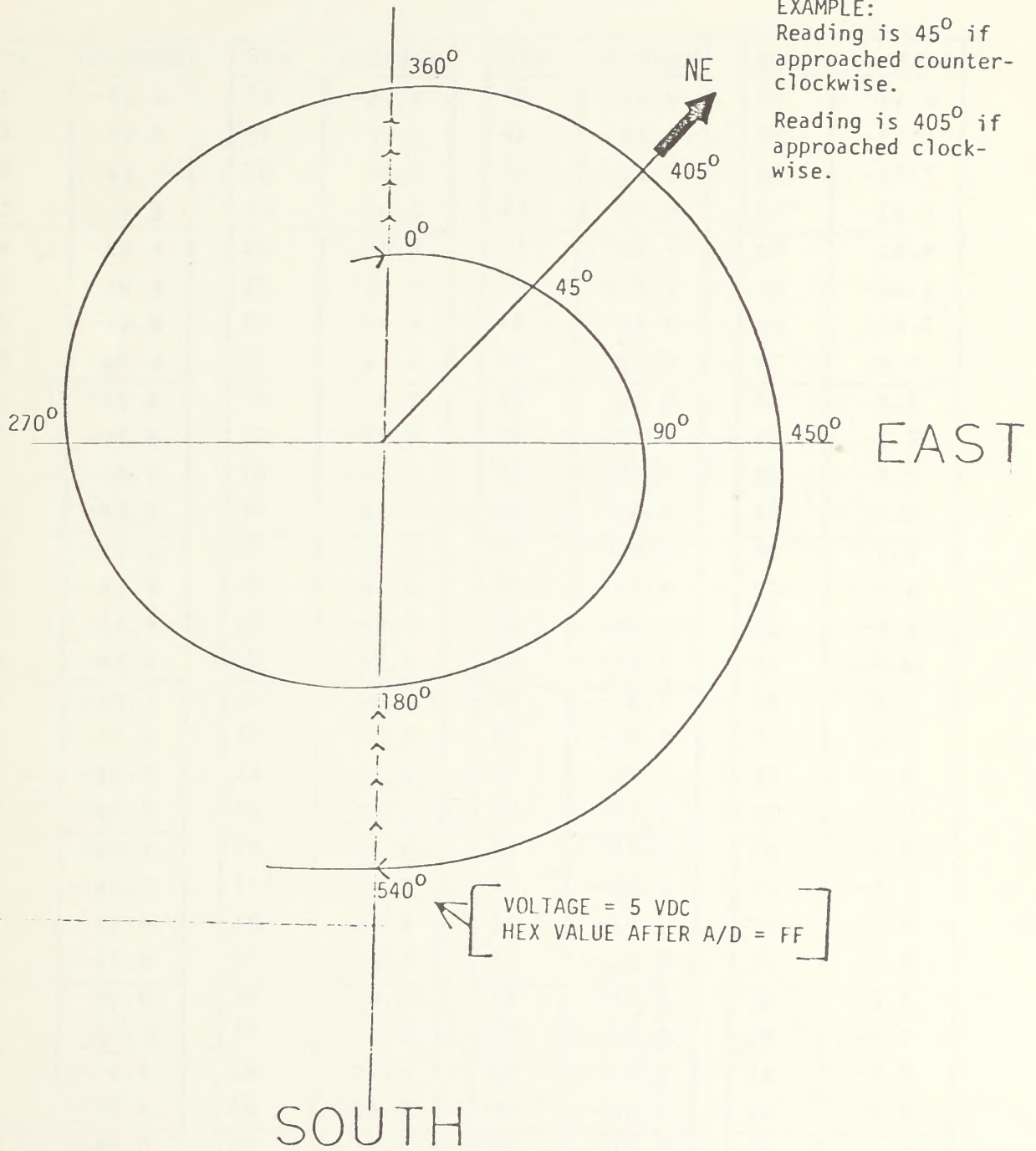
DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT

cont'd)

WIND DIRECTION (DEGREES)

HEX	Degrees	HEX	Degrees	HEX	Degrees	HEX	Degrees
80	270.0	A0	337.5	C0	405.0	E0	472.5
81	272.1	A1	339.6	C1	407.1	E1	474.6
82	274.2	A2	341.7	C2	409.2	E2	476.7
83	276.3	A3	343.8	C3	411.3	E3	478.8
84	278.4	A4	345.9	C4	413.4	E4	480.9
85	280.5	A5	348.0	C5	415.5	E5	483.0
86	282.6	A6	350.1	C6	417.6	E6	485.1
87	284.7	A7	352.2	C7	419.7	E7	487.2
88	286.8	A8	354.3	C8	421.8	E8	489.3
89	288.9	A9	356.4	C9	423.9	E9	491.4
8A	291.0	AA	358.5	CA	426.0	EA	493.5
8B	293.2	AB	360.7	CB	428.2	EB	495.7
8C	295.3	AC	362.8	CC	430.3	EC	497.8
8D	297.4	AD	364.9	CD	432.4	ED	499.9
8E	299.5	AE	367.0	CE	434.5	EE	502.0
8F	301.6	AF	369.1	CF	436.6	EF	504.1
90	303.7	B0	371.2	D0	438.7	F0	506.2
91	305.8	B1	373.3	D1	440.8	F1	508.3
92	307.9	B2	375.4	D2	442.9	F2	510.4
93	310.0	B3	377.5	D3	445.0	F3	512.5
94	312.1	B4	379.6	D4	447.1	F4	514.6
95	314.2	B5	381.7	D5	449.2	F5	516.7
96	316.4	B6	383.9	D6	451.4	F6	518.9
97	318.5	B7	386.0	D7	453.5	F7	521.0
98	320.6	B8	388.1	D8	455.6	F8	523.1
99	322.7	B9	390.2	D9	457.7	F9	525.2
9A	324.8	BA	392.3	DA	459.8	FA	527.3
9B	326.9	BB	394.4	DB	461.9	FB	529.4
9C	329.0	BC	396.5	DC	464.0	FC	531.5
9D	331.1	BD	398.6	DD	466.1	FD	533.6
9E	333.2	BE	400.7	DE	468.2	FE	535.7
9F	335.3	BF	402.8	DF	470.3	FF	537.8

NORTH



ROBERT

Date		Time		Place		Remarks	
1901	10/1	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/2	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/3	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/4	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/5	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/6	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/7	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/8	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/9	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/10	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/11	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/12	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/13	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/14	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/15	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/16	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/17	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/18	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/19	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/20	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/21	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/22	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/23	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/24	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/25	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/26	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/27	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/28	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/29	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/30	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul
1901	10/31	10:00	11:00	St. Paul	St. Paul	St. Paul	St. Paul

Location

2nd Digit

TEMPERATURE

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT
TEMPERATURE (DEGREES CENTIGRADE)

HEX	DEGREES
00	-50.0
01	-49.6
02	-49.2
03	-48.8
04	-48.4
05	-48.0
06	-47.6
07	-47.2
08	-46.8
09	-46.4
0A	-46.0
0B	-45.7
0C	-45.3
0D	-44.9
0E	-44.5
0F	-44.1
10	-43.7
11	-43.3
12	-42.9
13	-42.5
14	-42.1
15	-41.7
16	-41.4
17	-41.0
18	-40.6
19	-40.2
1A	-39.8
1B	-39.4
1C	-39.0
1D	-38.6
1E	-38.2
1F	-37.8

HEX	DEGREES
20	-37.5
21	-37.1
22	-36.7
23	-36.3
24	-35.9
25	-35.5
26	-35.1
27	-34.7
28	-34.3
29	-33.9
2A	-33.5
2B	-33.2
2C	-32.8
2D	-32.4
2E	-32.0
2F	-31.6
30	-31.2
31	-30.8
32	-30.4
33	-30.0
34	-29.6
35	-29.2
36	-28.9
37	-28.5
38	-28.1
39	-27.7
3A	-27.3
3B	-26.9
3C	-26.5
3D	-26.1
3E	-25.7
3F	-25.3

HEX	DEGREES
40	-25.0
41	-24.6
42	-24.2
43	-23.8
44	-23.4
45	-23.0
46	-22.6
47	-22.2
48	-21.8
49	-21.4
4A	-21.0
4B	-20.7
4C	-20.3
4D	-19.9
4E	-19.5
4F	-19.1
50	-18.7
51	-18.3
52	-17.9
53	-17.5
54	-17.1
55	-16.7
56	-16.4
57	-16.0
58	-15.6
59	-15.2
5A	-14.8
5B	-14.4
5C	-14.0
5D	-13.6
5E	-13.2
5F	-12.8

HEX	DEGREES
60	-12.5
61	-12.1
62	-11.7
63	-11.3
64	-10.9
65	-10.5
66	-10.1
67	-9.7
68	-9.3
69	-8.9
6A	-8.5
6B	-8.2
6C	-7.8
6D	-7.4
6E	-7.0
6F	-6.6
70	-6.2
71	-5.8
72	-5.4
73	-5.0
74	-4.6
75	-4.2
76	-3.9
77	-3.5
78	-3.1
79	-2.7
7A	-2.3
7B	-1.9
7C	-1.5
7D	-1.1
7E	-0.7
7F	-0.3

TEMPERATURE

☐ Location
☐ 2nd ☐
☐ Digit ☐

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT
 TEMPERATURE (DEGREES CENTIGRADE)

HEX	DEGREES	HEX	DEGREES	HEX	DEGREES	HEX	DEGREES
80	0:0	A0	+12.5	C0	+25.0	E0	+37.8
81	+0.3	A1	+12.8	C1	+25.3	E1	+38.2
82	+0.7	A2	+13.2	C2	+25.7	E2	+38.6
83	+1.1	A3	+13.6	C3	+26.1	E3	+39.0
84	+1.5	A4	+14.0	C4	+26.5	E4	+39.4
85	+1.9	A5	+14.4	C5	+26.9	E5	+39.8
86	+2.3	A6	+14.8	C6	+27.3	E6	+40.2
87	+2.7	A7	+15.2	C7	+27.7	E7	+40.6
88	+3.1	A8	+15.6	C8	+28.1	E8	+41.0
89	+3.5	A9	+16.0	C9	+28.5	E9	+41.4
8A	+3.9	AA	+16.4	CA	+28.9	EA	+41.7
8B	+4.2	AB	+16.7	CB	+29.2	EB	+42.1
8C	+4.6	AC	+17.1	CC	+29.6	EC	+42.5
8D	+5.0	AD	+17.5	CD	+30.0	ED	+42.9
8E	+5.4	AE	+17.9	CE	+30.4	EE	+43.3
8F	+5.8	AF	+18.3	CF	+30.8	EF	+43.7
90	+6.2	B0	+18.7	D0	+31.2	F0	+44.1
91	+6.6	B1	+19.1	D1	+31.6	F1	+44.5
92	+7.0	B2	+19.5	D2	+32.0	F2	+44.9
93	+7.4	B3	+19.9	D3	+32.4	F3	+45.3
94	+7.8	B4	+20.3	D4	+32.8	F4	+45.7
95	+8.2	B5	+20.7	D5	+33.2	F5	+46.0
96	+8.5	B6	+21.0	D6	+33.5	F6	+46.4
97	+8.9	B7	+21.4	D7	+33.9	F7	+46.8
98	+9.3	B8	+21.8	D8	+34.7	F8	+47.2
99	+9.7	B9	+22.2	D9	+35.1	F9	+47.6
9A	+10.1	BA	+22.6	DA	+35.5	FA	+48.0
9B	+10.5	BB	+23.0	DB	+35.9	FB	+48.4
9C	+10.9	BC	+23.4	DC	+36.3	FC	+48.8
9D	+11.3	BD	+23.8	DD	+36.7	FD	+49.2
9E	+11.7	BE	+24.2	DE	+37.1	FE	+49.6
9F	+12.1	BF	+24.6	DF	+37.5	FF	+50.0



Location

RELATIVE HUMIDITY

2nd
Digit

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT

RELATIVE HUMIDITY (PER CENT)



HEX	PER CENT	HEX	PER CENT	HEX	PER CENT	HEX	PER CENT
00	0.0	20	12.5	40	25.0	60	37.8
01	0.3	21	12.8	41	25.3	61	38.2
02	0.7	22	13.2	42	25.7	62	38.6
03	1.1	23	13.6	43	26.1	63	29.0
04	1.5	24	14.0	44	26.5	64	39.4
05	1.9	25	14.4	45	26.9	65	39.8
06	2.3	26	14.8	46	27.3	66	40.2
07	2.7	27	15.2	47	27.7	67	40.6
08	3.1	28	15.6	48	28.1	68	41.0
09	3.5	29	16.0	49	28.5	69	41.4
0A	3.9	2A	16.4	4A	28.9	6A	41.7
0B	4.2	2B	16.7	4B	29.2	6B	42.1
0C	4.6	2C	17.1	4C	29.6	6C	42.5
0D	5.0	2D	17.5	4D	30.0	6D	42.9
0E	5.4	2E	17.9	4E	30.4	6E	43.3
0F	5.8	2F	18.3	4F	30.8	6F	43.7
10	6.2	30	18.7	50	31.2	70	44.1
11	6.6	31	19.1	51	31.6	71	44.5
12	7.0	32	19.5	52	32.0	72	44.9
13	7.4	33	19.9	53	32.4	73	45.3
14	7.8	34	20.3	54	32.8	74	45.7
15	8.2	35	20.7	55	33.2	75	46.0
16	8.5	36	21.0	56	33.5	76	46.4
17	8.9	37	21.4	57	33.9	77	46.8
18	9.3	38	21.8	58	34.7	78	47.2
19	9.7	39	22.2	59	35.1	79	47.6
1A	10.1	3A	22.6	5A	35.5	7A	48.0
1B	10.5	3B	23.0	5B	35.9	7B	48.4
1C	10.9	3C	23.4	5C	36.3	7C	48.8
1D	11.3	3D	23.8	5D	36.7	7D	49.2
1E	11.7	3E	24.2	5E	37.1	7E	49.6
1F	12.1	3F	24.6	5F	37.5	7F	50.0



Location

2nd

Digit

RELATIVE HUMIDITY

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT

RELATIVE HUMIDITY (PER CENT) (cont'd)

HEX	PER CENT	HEX	PER CENT	HEX	PER CENT	HEX	PER CENT
80	50.3	A0	62.8	C0	75.3	E0	87.8
81	50.7	A1	63.2	C1	75.7	E1	88.2
82	51.1	A2	63.6	C2	76.1	E2	88.6
83	51.5	A3	64.0	C3	76.5	E3	89.0
84	51.9	A4	64.4	C4	76.9	E4	89.4
85	52.3	A5	64.8	C5	77.3	E5	89.8
86	52.7	A6	65.2	C6	77.7	E6	90.2
87	53.1	A7	65.6	C7	78.1	E7	90.6
88	53.5	A8	66.0	C8	78.5	E8	91.0
89	53.9	A9	66.4	C9	78.9	E9	91.4
8A	54.2	AA	66.7	CA	79.2	EA	91.7
8B	54.6	AB	67.1	CB	79.6	EB	92.1
8C	55.0	AC	67.5	CC	80.9	EC	92.5
8D	55.4	AD	67.9	CD	80.4	ED	92.9
8E	55.8	AE	68.3	CE	80.8	EE	93.3
8F	56.2	AF	68.7	CF	81.2	EF	93.7
90	56.6	B0	69.1	D0	81.6	F0	94.1
91	67.0	B1	69.5	D1	82.0	F1	94.5
92	57.4	B2	69.9	D2	82.4	F2	94.9
93	57.8	B3	70.3	D3	82.8	F3	95.3
94	58.2	B4	70.7	D4	83.2	F4	95.7
95	58.5	B5	71.0	D5	83.5	F5	96.0
96	58.9	B6	71.4	D6	83.9	F6	96.4
97	59.3	B7	71.8	D7	84.3	F7	96.8
98	59.7	B8	72.2	D8	84.7	F8	97.2
99	60.1	B9	72.6	D9	85.1	F9	97.6
9A	60.5	BA	73.0	DA	85.5	FA	98.0
9B	60.9	BB	73.4	DB	85.9	FB	98.4
9C	61.3	BC	73.8	DC	86.3	FC	98.8
9D	61.7	BD	74.2	DD	86.7	FD	99.2
9E	62.1	BE	74.6	DE	87.1	FE	99.6
9F	62.5	BF	75.0	DF	87.5	FF	100.0

A/D# BAROMETRIC PRESSURE

MEMORY LOCATION

1st 2nd

Digit Digit

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT
INCHES OF MERCURY

HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.
00	24.00	20	24.87	40	25.74	60	26.62
01	24.02	21	24.90	41	25.77	61	26.65
02	24.05	22	24.92	42	25.80	62	26.67
03	24.08	23	24.95	43	25.83	63	26.70
04	24.10	24	24.98	44	25.85	64	26.73
05	24.13	25	25.01	45	25.88	65	26.76
06	24.16	26	25.03	46	25.91	66	26.78
07	24.19	27	25.06	47	25.94	67	26.81
08	24.21	28	25.09	48	25.96	68	26.84
09	24.24	29	25.12	49	25.99	69	26.87
0A	24.27	2A	25.14	4A	26.02	6A	26.89
0B	24.30	2B	25.17	4B	26.05	6B	26.92
0C	24.32	2C	25.20	4C	26.07	6C	26.95
0D	24.35	2D	25.23	4D	26.10	6D	26.98
0E	24.38	2E	25.25	4E	26.13	6E	27.00
0F	24.41	2F	25.28	4F	26.15	6F	27.03
10	24.43	30	25.31	50	26.18	70	27.06
11	24.46	31	25.33	51	26.21	71	27.08
12	24.49	32	25.36	52	26.24	72	27.11
13	24.51	33	25.39	53	26.26	73	27.14
14	24.54	34	25.42	54	26.29	74	27.17
15	24.57	35	25.44	55	26.32	75	27.19
16	24.60	36	25.47	56	26.35	76	27.22
17	24.62	37	25.50	57	26.37	77	27.25
18	24.65	38	25.53	58	26.40	78	27.28
19	24.68	39	25.55	59	26.43	79	27.30
1A	24.71	3A	25.58	5A	26.46	7A	27.33
1B	24.73	3B	25.61	5B	26.48	7B	27.36
1C	24.76	3C	25.64	5C	26.51	7C	27.39
1D	24.79	3D	25.66	5D	26.54	7D	27.41
1E	24.82	3E	25.69	5E	26.56	7E	27.44
1F	24.84	3F	25.72	5F	26.59	7F	27.47

/D# BAROMETRIC PRESSURE

Y LOCATION

 2nd
Digit

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT

INCHES OF MERCURY

HEX	In.Hg.
80	27.49
81	27.52
82	27.55
83	27.58
84	27.60
85	27.63
86	27.66
87	27.69
88	27.71
89	27.74
8A	27.77
8B	27.80
8C	27.82
8D	27.85
8E	27.88
8F	27.90
90	27.93
91	27.96
92	27.99
93	28.01
94	28.04
95	28.07
96	28.10
97	28.12
98	28.15
99	28.18
9A	28.21
9B	28.23
9C	28.26
9D	28.29
9E	28.31
9F	28.34

HEX	In.Hg.
A0	28.37
A1	28.40
A2	28.42
A3	28.45
A4	28.48
A5	28.51
A6	28.53
A7	28.56
A8	28.59
A9	28.62
AA	28.64
AB	28.67
AC	28.70
AD	28.72
AE	28.75
AF	28.78
B0	28.81
B1	28.83
B2	28.86
B3	28.83
B4	28.92
B5	28.94
B6	28.97
B7	29.00
B8	29.03
B9	29.05
BA	29.08
BB	29.11
BC	29.13
BD	29.16
BE	29.19
BF	29.22

HEX	In.Hg.
C0	29.24
C1	29.27
C2	29.30
C3	29.33
C4	29.35
C5	29.38
C6	29.41
C7	29.44
C8	29.46
C9	29.49
CA	29.52
CB	29.55
CC	29.57
CD	29.60
CE	29.63
CF	29.65
D0	29.68
D1	29.71
D2	29.74
D3	29.76
D4	29.79
D5	29.82
D6	29.85
D7	29.87
D8	29.90
D9	29.93
DA	29.96
DB	29.98
DC	30.01
DD	30.04
DE	30.06
DF	30.09

HEX	In.Hg.
E0	30.12
E1	30.15
E2	30.17
E3	30.20
E4	30.23
E5	30.26
E6	30.28
E7	30.31
E8	30.34
E9	30.37
EA	30.39
EB	30.42
EC	30.45
ED	30.47
EE	30.50
EF	30.53
F0	30.56
F1	30.58
F2	30.61
F3	30.64
F4	30.67
F5	30.69
F6	30.72
F7	30.75
F8	30.78
F9	30.80
FA	30.83
FB	30.86
FC	30.88
FD	30.91
FE	30.94
FF	30.97

☐ ry Location
 t 2nd
] Digit
 ☐

BATTERY MONITOR DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT BATTERY VOLTAGE (VDC)

HEX	VDC
2E	8.9
2F	9.1
30	9.3
31	9.5
32	9.7
33	9.9
34	10.1
35	10.3
36	10.5
37	10.7
38	10.9
39	11.1
3A	11.3
3B	11.5
3C	11.7
3D	11.9
3E	12.1
3F	12.3
40	12.5
41	12.7
42	12.8
43	13.0
44	13.2
45	13.4
46	13.6
47	13.8
48	14.0
49	14.2
4A	14.4
4B	14.6
4C	14.8
4D	15.0

Explanation

There is a problem with unexpected messages received, and expected messages not received. For example:

259235527 ^^ expected message not received
(the computer expected platform to transmitt in its assigned time frame)

2600000908 B222LAGG ECT...
(data was actually transmitted 15 minutes late, but still was entered and disseminated)

2600000908 ^^ unexpected message received
(this indicates that the previous data was accepted, but it is not in the assigned time frame)

13KCLKLKLKLYUYU

Seasmore Tuluho
Test

DCS - ENTER ID.
BLM001

NUMBER OF UNDISSEMINATED MESSAGES 0000
TIME OF LAST DISSEMINATION 262180921
ENTER: MSG,RLT,DIS, OR STOP RLT,259000000

16CE8A82 259145240 B000L0LG0000BAIDMGB00000CH0000AAIDCHE000L0GE0000BAIDG
EB000L0EF0000AAIDEFB000LALG0000AAIDLGB000L0DF0000AAIDOFB000BABG0000AAIDB
GB000NA0H0000CAID0H

16CE8A82 259145240 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 259145519 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 259175240 B000L0EF0000AAIDEFB000LALG0000AAIDLGB000L0DF0000AAIDG
FB000BABG0000AAIDBGB000NA0H0000CAID0HB0000B0G0000CAKIDGGB000LAGG0000DAMDG
GB000HABG0000DALDBG

16CE8A82 259175240 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 259175507 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 259205519 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 259210908 B000BABG0000AAIDBGB000NA0H0000CAID0HB0000B0G0000CAKIDG
GB000LAGG0000DAMDGGB000HABG0000DALDBGGB000IBNF0000DAHONFB000HBKF0000DALDK
FB000FCA60000DALDAG

16CE8A82 259210908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 259235527 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260000908 B000LAGG0000DAMDGGB000HABG0000DALDBGGB000IBNF0000DAHON
FB000HBKF0000DALDKFB000FCA60000DALDAGB000ECLF0000DAODLFB000BCJG0000DAMDJ
GB000JCKG0000DALDKG

16CE8A82 260000908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260025504 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260030908 B000HBKF0000DALDKFB000F0A60000DALDAGB0000ECLF0000DADDL
FB000BCUG0000DAMDUGB000JCKG0000DALDKGB000FBIG0000EAKDI6B000NAEG0000DAJDE
GB000CBEG0000EAJDGF

16CE8A82 260030908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260055516 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260055519 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260060908 B000BCUG0000DAMDUGB000JCKG0000DALDKGB000FBIG0000EAKDI
GB000NAEG0000DAJDEGB000CBEG0000EAJDGFGB000HAMF0000EAJDMFB000BAAG0000EAJDA
GB000IANF0000EAJDNF

16CE8A82 260060908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260085518 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260090908 B000NAEG0000DAJDEGB000CBEG0000EAJDGFGB000HAMF0000EAJDM
FB000BAAG0000EAJDAGB000IANF0000EAJDNFB000KADG0000FAIDCGB000NAGG0000FAIDH
GB000ABG0000FAIDBG

16CE8A82 260090908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260115510 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260120908 B000BAAG0000EAJDAGB000IANF0000EAJDNFB000KADG0000FAIDC
GB000NAGG0000FAIDHGB000ABG0000FAIDBGB000KAGG0000FAIDFGB000LANG0000GAIDH
GB000EAGG0000HAIDAG

16CE8A82 260120908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260145525 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260150908 B000NAGG0000FAIDHGB000ABG0000FAIDBGB000KAGG0000FAIDF
GB000LANG0000GAIDHGB000EAGG0000HAIDAGB000AFG0000HAIDFGB000ABMF0000IAIDN
FB0000B0G0000JALD0G

16CE8A82 260150908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260175503 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260180908 B000L0NG0000GAIDNGB000E0AG0000HAID0GB0000AF0000HAIDF
GB0000B0MF0000IAIDNF B0000B00000JALD0GB0000HANF0000KAMDNF B000FBF0000KANDG
GB000BB0G0000LAND0G

16CE8A82 260180908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260205505 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260210908 B000B0MF0000IAIDNF B0000B00000JALD0GB0000HANF0000KAMDN
FB000FBF00000KANDGGB000BB0G0000LAND0GB0000MALG0000MAMD0GB000NBFF0000MA0EF
FB000IBH00000MA0DHG

16CE8A82 260210908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260235513 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261000908 B000FBF00000KANDGGB000BB0G0000LAND0GB0000MALG0000MAMD0
GB000NBFF0000MA0EFFB000IBH00000MA0DHGGB000MABG0000MAMD0GB0000CALF0000MAMD0
FB000DAMF0000MALDMF

16CE8A82 261000908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261025504 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261030908 B000NBFF0000MA0EFFB000IBH00000MA0DHGGB000MABG0000MAMD0
GB0000CALF0000MAMD0FB000DAMF0000MALDMFB000FACF0000MAKIDCFB000L0KE0000LAJDK
EB000K0ME0000LAJDM0

16CE8A82 261030908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261055524 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261060908 B0000CALF0000MAMD0FB000DAMF0000MALDMFB000FACF0000MAKIDC
FB000L0KE0000LAJDK0EB000K0ME0000LAJDM0EB000NB0JF0000MAJ0JFB0000AHE0000MAJDN
EB0000AHE0000MAJDHE

16CE8A82 261060908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261085532 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261090908 B000L0KE0000LAJDK0EB000K0ME0000LAJDM0EB000NB0JF0000MAJ0J
FB0000AHE0000MAJDHEB0000AHE0000MAJDHEB000NB0JE0000LAJD0EB000M0AF0000LAID0
FB00000HE0000LAIDHE

16CE8A82 261090908 ^^UNEXPECTED MESSAGE RECEIVED.

00000000 261114324 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE

ON JULIAN DAY 261 -- (18 SEPTEMBER 1977) .

EAST SATELLITE ECLIPSE OUTAGE --

DCPI WAS DOWN FROM 0415 ZULU TILL 0532 ZULU .

WEST SATELLITE ECLIPSE OUTAGE --

DCPI WAS DOWN 0810 ZULU
TILL 1005 ZULU .

16CE8A82 261120908 B000AANE0000MAJDNEB0000AHE0000MAJDHEB0000N0JE0000LAIDJ
EB0000M0AF0000LAIDAFB000003HE0000LAIDHEB0000N0KE0000LAIDLEB0000L0DF0000LAIDC
FB000003EF0000LAIDDF

16CE8A82 261150909 ^^ADDRESS RECEIVED WITH ERROR AS: 9DC8BA9A

16CE8A82 261180908 B000L0DF0000LAIDCFB000003EF0000LAIDDFB0000H0BF0000LAIDB
FB0000J0NF0000LAIDNFB0000K0ND0000MAKINDNB0000CAFID0000MANDEIB0000M0GG0000MANDH
GB0000KAFE0000MANDFE

16CE8A82 261210908 B000J0NF0000LAIDNFB0000K0ND0000MAKINDNB0000CAFID0000MANDE
IB0000M0GG0000MANDHGB0000KAFE0000MANDFEB0000J0GE0000N0ADODIB000003JC0000MANDJ
CB0000HAJC0000MANDJC

16CE8A82 262000908 B000M0GG0000MANDHGB0000KAFE0000MANDFEB0000J0GE0000N0ADOD
IB000003JC0000MANDJCB0000HAJC0000MANDJCB0000N0AD0000LAND0IB0000IAND0000KAMD
IB000003GE0000JALIGE

16CE8A82 262030908 B00003JC0000MANDJCB0000HAJC0000MANDJCB0000N0AD0000LAND0
IB0000IAND0000KAMDIB000003GE0000JALIGEB0000NAFE0000JAJDEEB0000EAGE0000IAJD
EB0000G0GD0000IAJDGD

16CE8A82 262060908 B000IAND0000KAMDIB000003GE0000JALIGEB0000NAFE0000JAJDE
EB0000EAGE0000IAJDGEB0000G0GD0000IAJDGEB0000L0AF0000HAJDHAFB0000B0GJ0000HAJDH
JB0000I00J0000HAIDOI

16CE8A82 262090908 B000EAGE0000IAJDGEB0000G0GD0000IAJDGEB0000L0AF0000HAJDH
FB0000B0GJ0000HAJDHJB0000I00J0000HAIDOIIB0000L0BG0000GAIDGBE0000N0DE0000GAIDH
EB0000K0GD0000FAIDGD

00000000 262112241 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE ON

JULIAN DAY 262 --- (19 SEPTEMBER 1977) .

EAST SATELLITE

DCPI WAS DOWN FROM 0420 ZULU TILL 0552 ZULU .

WEST SATELLITE DCPI

WAS DOWN FROM 0808 ZULU TILL 1007 ZULU .

THE DCPI'S ON EACH SA

TELLITE WERE DOWN FOR LESS THAN ONE

MINUTE EACH WHILE SWITCHING TO

BACKUP ANTENNAS .

16CE8A82 262120908 B000B06J00000HAJDHJB000I00J0000HAID0IB000L0B00000GAIDB
GB000N0DE00000GAIDDEB000K0GD0000FAIDGDB0000AANE0000FAIDNEB00000EE0000FAIDE
EB000BACE0000FAIDCE

16CE8A82 262150908 B000N0DE00000GAIDDEB000K0GD0000FAIDGDB0000AANE0000FAIDN
EB00000EE0000FAIDEEB000BACE0000FAIDCEB000EAMF0000FAIDMF0000HAGE0000FAID0
EB000J0NE0000FAIDNE

16CE8A82 262180908 B00000EE00000FAIDEEB000BACE0000FAIDCEB000EAMF0000FAIDM
FB000HAGE0000FAID0EB000J0NE0000FAIDNEB00000AF0000FAIDAFB000M0L00000FAMD
GB000BAKH00000GANDKH

00000000 262201859 ^^DCS OPERATOR HERE. I SEE YOU GOT IN OKAY.

11

YES THANKS AND TALK TO YOU SOON

160E8A82 262210908 B000HAE0000FAID0EB000J0NE0000FAJ0NEB000D0AF0000FAJ0A
FB000M0L60000FAMIDL6B000BAKH0000GANDKHB000DBCK0000FALDCKB000IA6J0000FALD6
JB000D00I0000FALD0J

160E8A82 263000908 B000M0L60000FAMIDL6B000BAKH0000GANDKHB000DBCK0000FALD0
KB000IA6J0000FALD6JB000D00I0000FALD0JB000D0AKI0000GAKDKIC000GAD60000GAKIC
GC000N0DE0000HAKID0E

160E8A82 263030908 B000IA6J0000FALD6JB000D00I0000FALD0JB000D0AKI0000GAKDK
IC000GAD60000GAKICGC000N0DE0000HAKID0EID000MA0F0000HAJ0D6ID000AALE0000HAJ0L
ED000BA0E0000GAJ0D0E

160E8A82 263060908 C000GAD60000GAKICGC000N0DE0000HAKID0EID000MA0F0000HAJ0D
GD000AALE0000HAJ0LED000BA0E0000GAJ0D0ED000M000000000HAID0FD000AAE0000HAIDA
ED000N0F60000HAIDF6

160E8A82 263091019 ^^EXPECTED MESSAGE NOT RECEIVED.

00000000 263112438 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE
Q

N JULIAN DAY 263 --- (20 SEPTEMBER 1977) .

EAST SATELLITE EC

LIPSE OUTAGE --

DCPI WAS DOWN FROM 0410 ZULU TILL 0547 ZULU

DCPR WAS DOWN FROM 0429 ZULU TILL 0439 ZULU .

WEST SA

TELLITE ECLIPSE OUTAGE ---

DCPI WAS DOWN FROM 0807 ZULU TIL

L 1007 ZULU .

DCPR WAS DOWN FROM 0819 ZULU TILL 0926 ZULU ,

AND FROM 0936 ZULU TILL 0940 ZULU .

160E8A82 263120908 D0000AAE0000HAIDAED000N0F60000HAIDF6D000D0HG0000HAIDH
GD000DAJ60000IAIDK6D000K0E60000IAIDE6D000H0N60000IAID06D000KAE60000JAIDD
GD000IAI60000JAIDJ6

160E8A82 263150908 D000DAJ60000IAIDK6D000K0E60000IAIDE6D000H0N60000IAID0
GD000KAE60000JAIDD6D000IAI60000JAIDJ6D000K00H0000JAID0HID0000AC60000JAIDD
GD000L0M60000KAIDM6

SAMPLE OF 1200 BAUD

DCS - ENTER ID. BLM001
YOU ENTERED AN INGORRECT ID - PLEASE ENTER CORRECT ID BLM001
NUMBER OF UNDISSEMINATED MESSAGES 0000
TIME OF LAST DISSEMINATION 263180921
ENTER: MSG,RLT,DIS, OR STOP RLT,263000000

16GE8A82 263000908 B@@@M@LG@@@FAMD LGB@@@BAKH@@@GANDKHB@@@DBGK@@@FALDG
KB@@@IAGJ@@@FALDGJB@@@O@OI@@@FALD@JB@@@OAKI@@@GAKDKIC@@@GADG@@@GAKDG
GG@@@N@OE@@@HAKDOE

16GE8A82 263030908 B@@@IAGJ@@@FALDGJB@@@O@OI@@@FALD@JB@@@OAKI@@@GAKDK
IG@@@GADG@@@GAKDGGG@@@N@OE@@@HAKDOED@@@MAOF@@@HAJD@GD@@@AALE@@@HAJDL
ED@@@BA@E@@@GAJD@E

16GE8A82 263060908 G@@@GADG@@@GAKDGGC@@@N@OE@@@HAKDOED@@@MAOF@@@HAJD@
GD@@@AALE@@@HAJDLED@@@BA@E@@@GAJD@ED@@@M@@G@@@HAIDOFD@@@AAE@@@HAIDA
ED@@@N@FG@@@HAIDFG

16GE8A82 263091019 ☹☹EXPECTED MESSAGE NOT RECEIVED.

00000000 263112438 ☹☹THE FOLLOWING OUTAGES TOOK PLAGE DURING ECLIPSE
O

N JULIAN DAY 263 --- (20 SEPTEMBER 1977) .

EAST SATELLITE EG

LIPSE OUTAGE --

DGPI WAS DOWN FROM 0410 ZULU TILL 0547 ZULU

DCPR WAS DOWN FROM 0429 ZULU TILL 0439 ZULU .

WEST SA

TELLITE ECLIPSE OUTAGE ---

DGPI WAS DOWN FROM 0807 ZULU TIL

L 1007 ZULU .

DGPR WAS DOWN FROM 0819 ZULU TILL 0926 ZULU ,

AND FROM 0936 ZULU TILL 0940 ZULU .

16GE8A82 263120908 D@@@@AAE@@@@HAIDAED@@@N@FG@@@HAIDFGD@@@O@HG@@@@HAIDH
GD@@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDOGD@@@KAEG@@@@JAIDD
GD@@@@IAIG@@@@JAIDJG

16GE8A82 263150908 D@@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDO
GD@@@@KAEG@@@@JAIDDGD@@@@IAIG@@@@JAIDJGD@@@K@H@@@@JAID@HD@@@@AGG@@@@JAIDD
GD@@@@L@MG@@@@KAIDMG

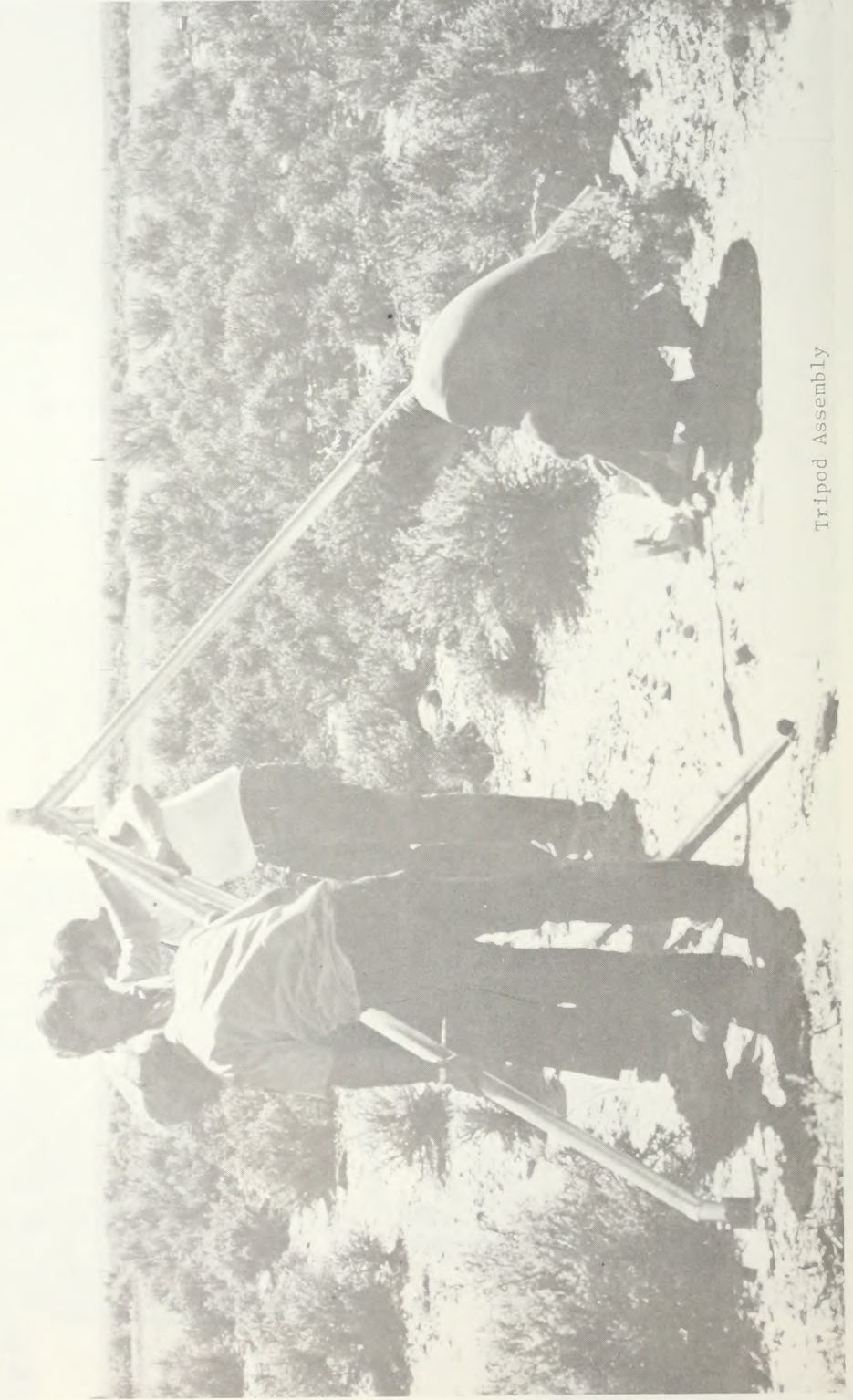
4. The fourth part of the document discusses the implications of the findings. It suggests that the results of the study have significant implications for the field of research and may lead to further developments in the future.

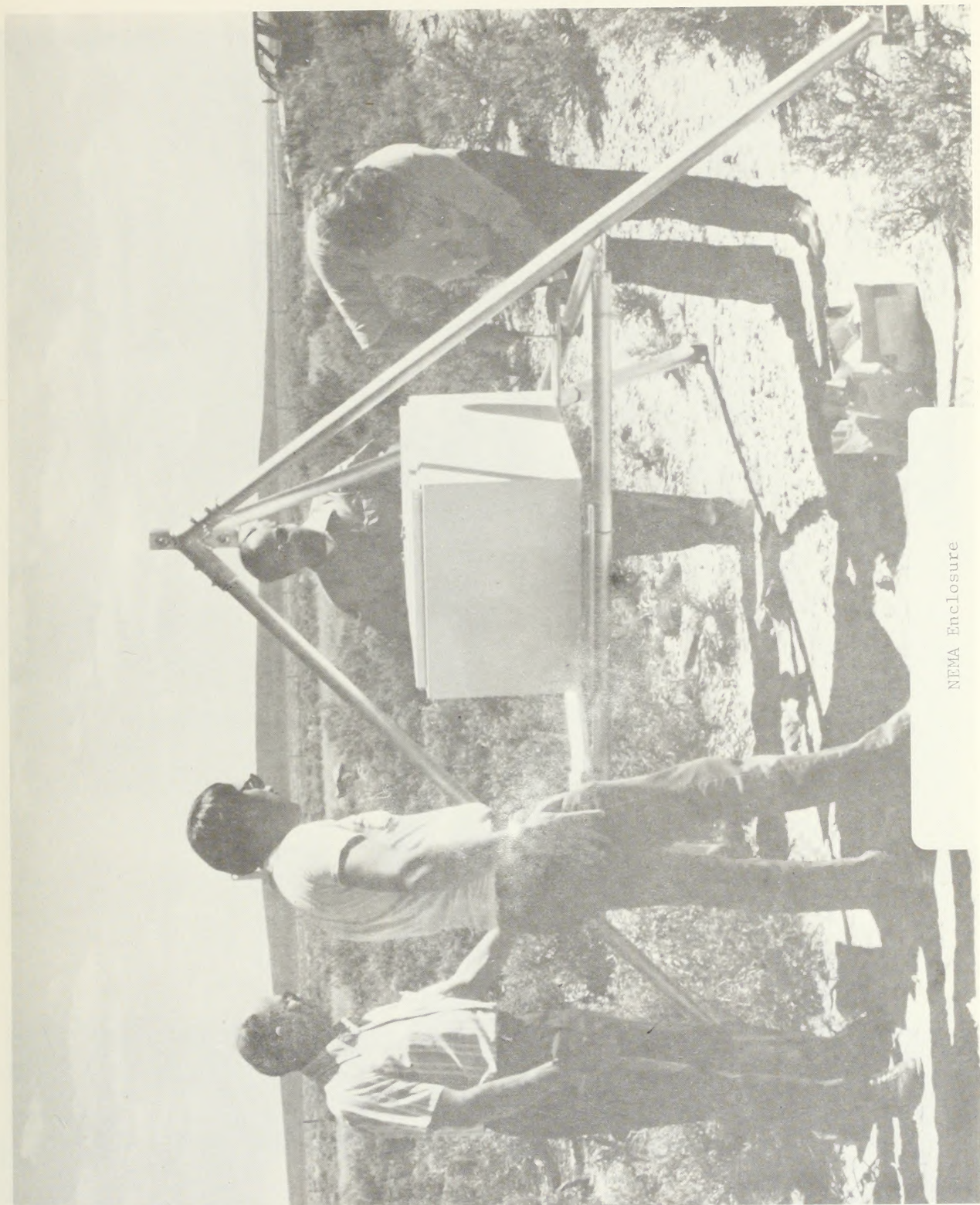
5. The fifth part of the document concludes the study and provides a summary of the key findings. It also includes a list of references and a bibliography of the sources used in the research.



Automatic Remote Weather Station
(Grasmere, Idaho)

Tripod Assembly





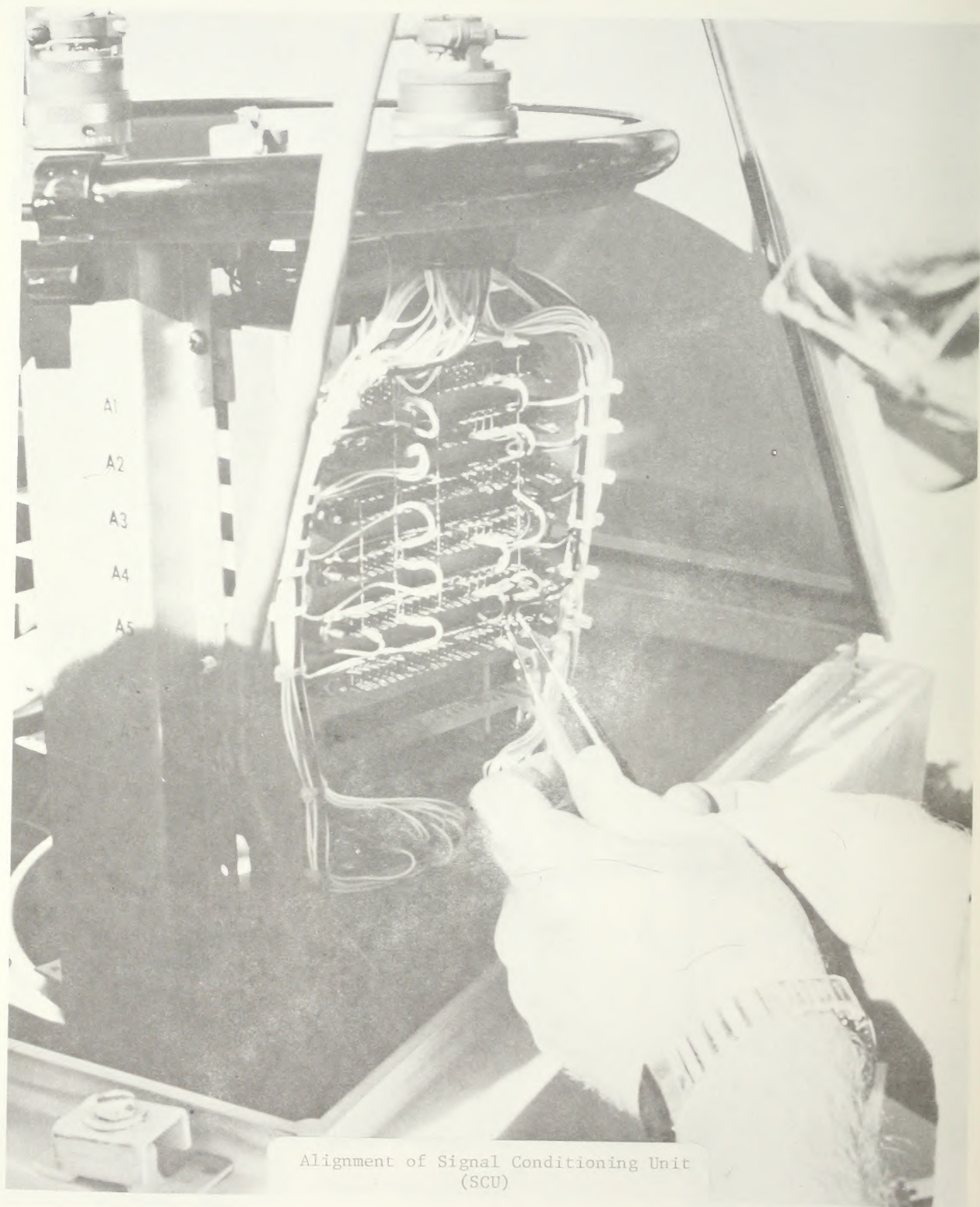
NEMA Enclosure



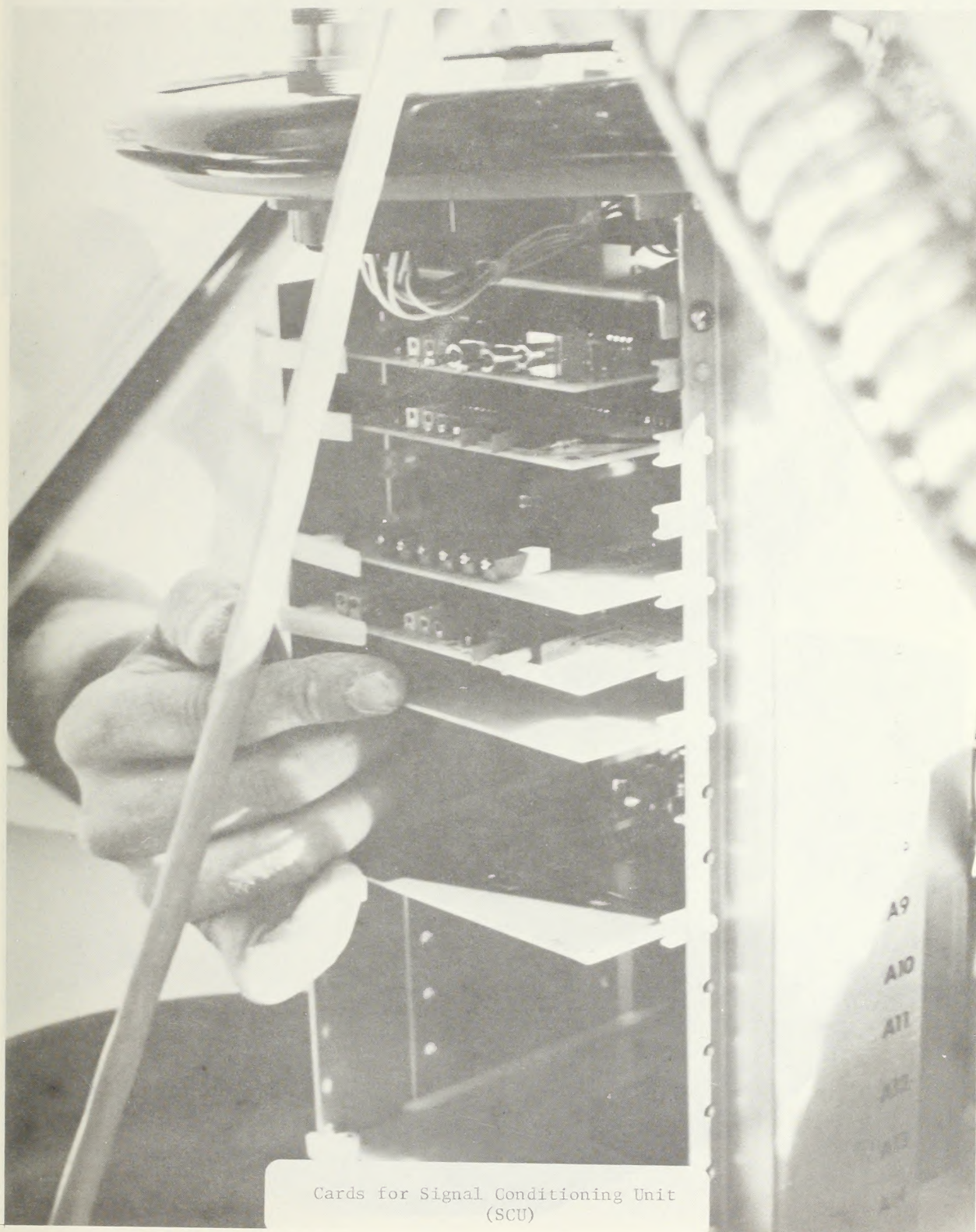
Crossarm Assembly
(Note Weight Support)



Conduit for Cable Protection



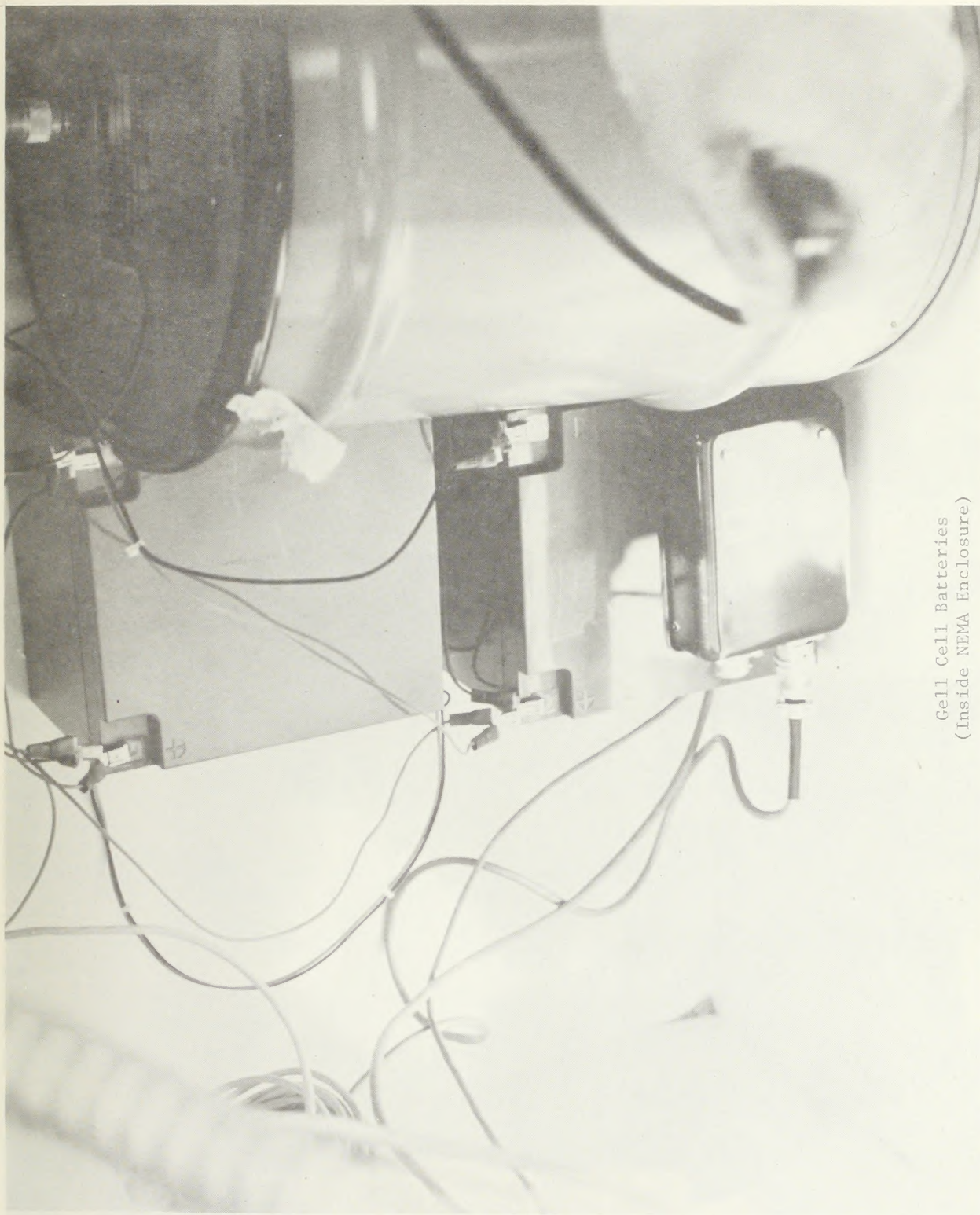
Alignment of Signal Conditioning Unit
(SCU)



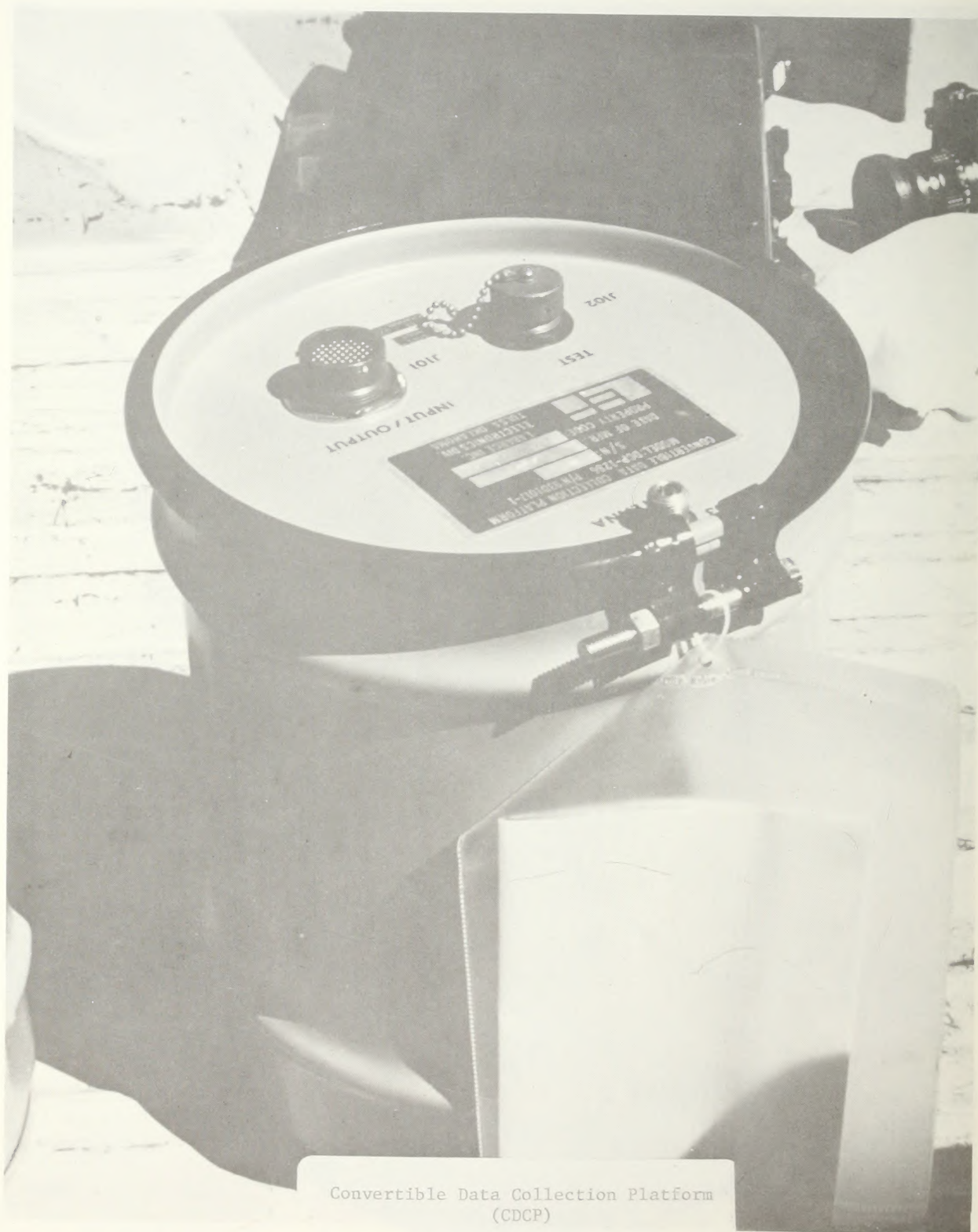
Cards for Signal Conditioning Unit
(SCU)

Signal Conditioning Unit
(SCU)

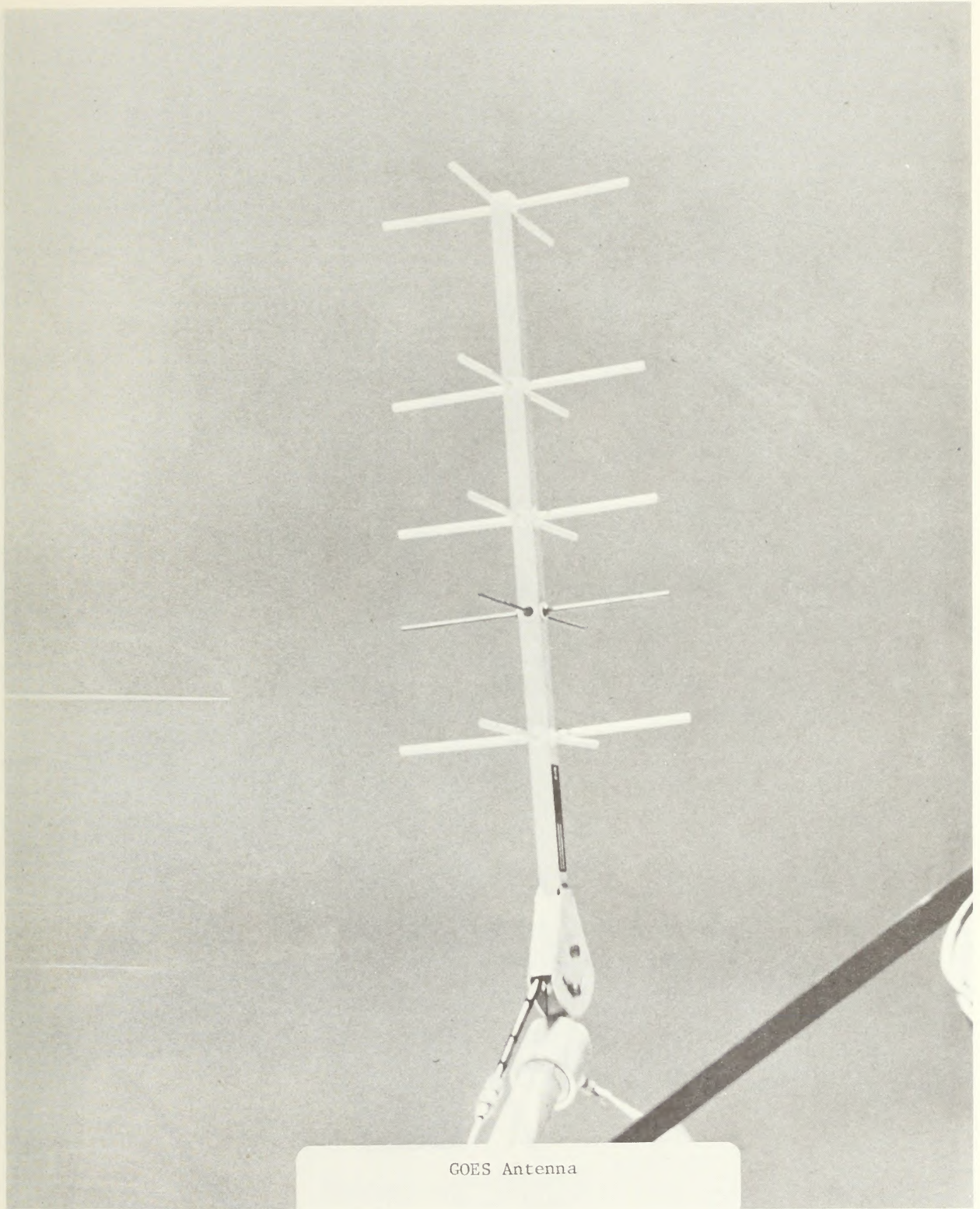




Cell Cell Batteries
(Inside NEMA Enclosure)



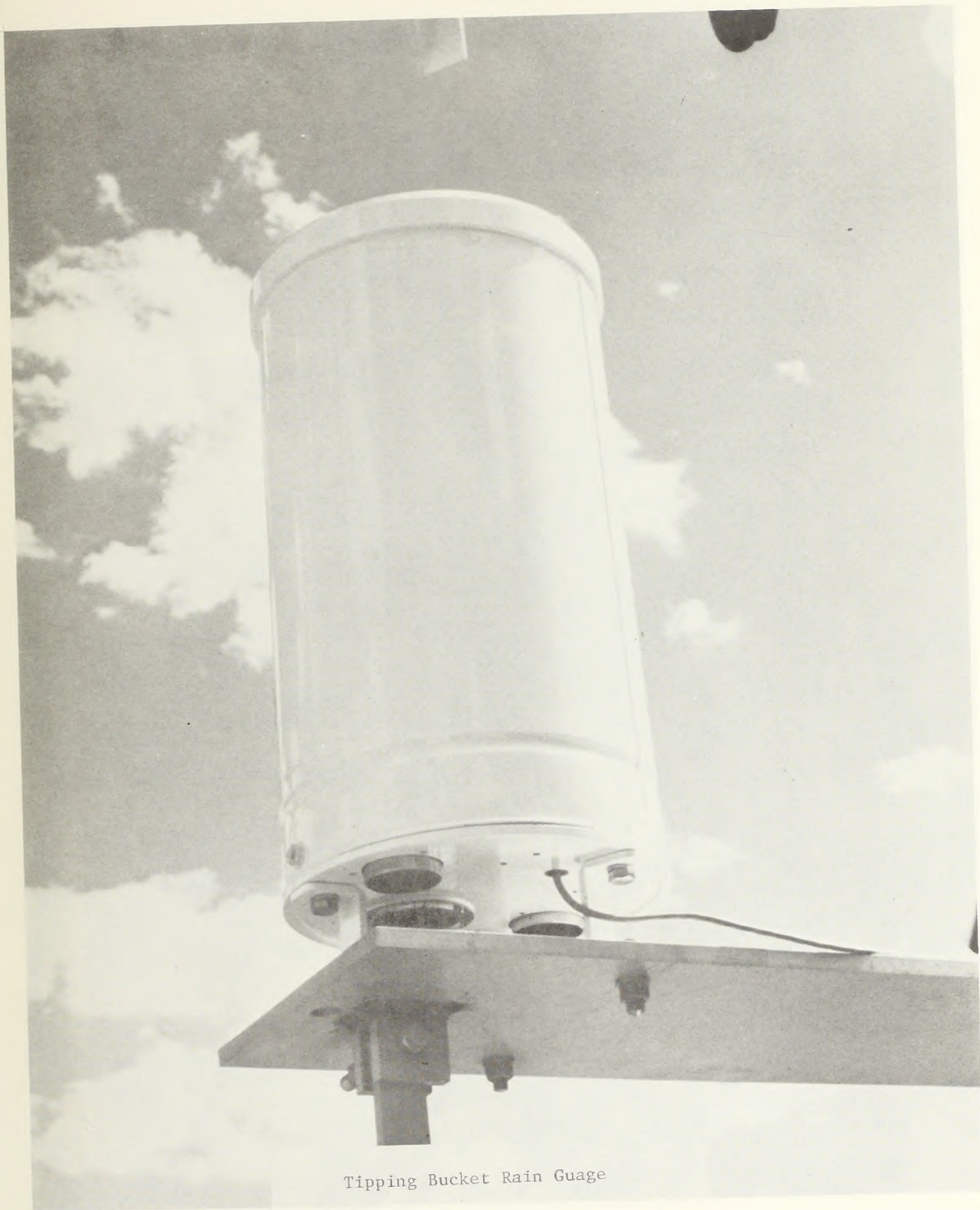
Convertible Data Collection Platform
(CDCP)



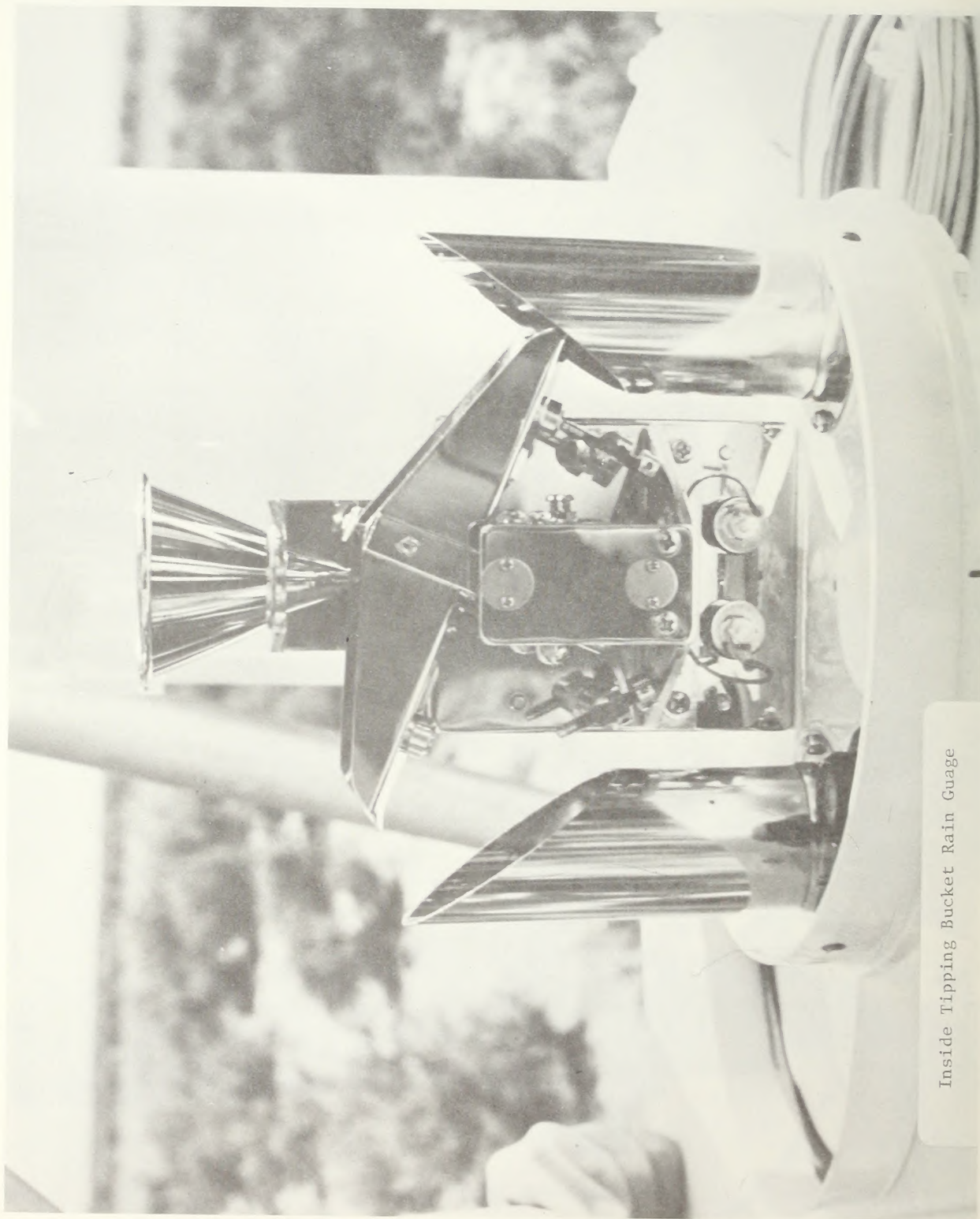
GOES Antenna



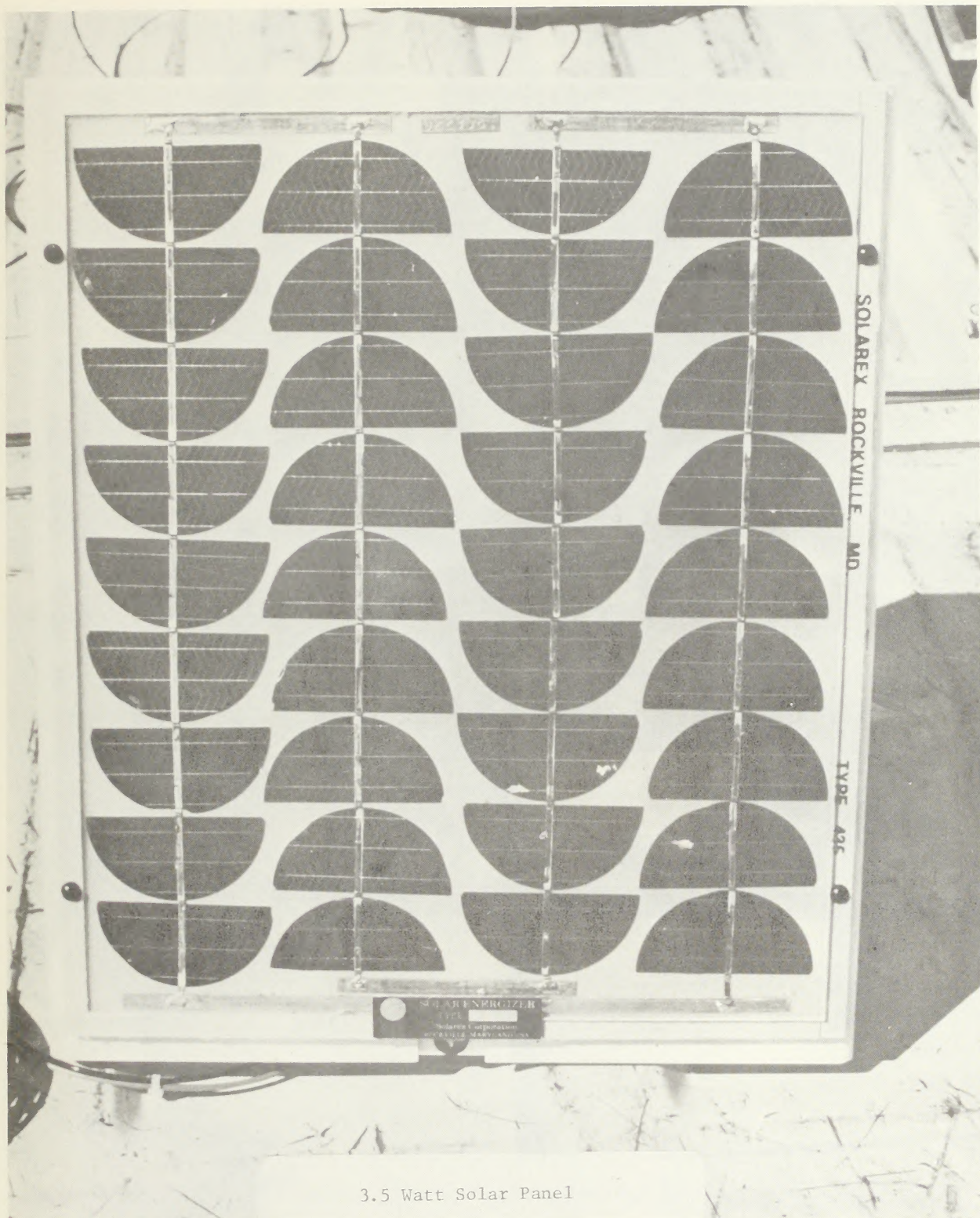
Anemometer
(Wind Speed)



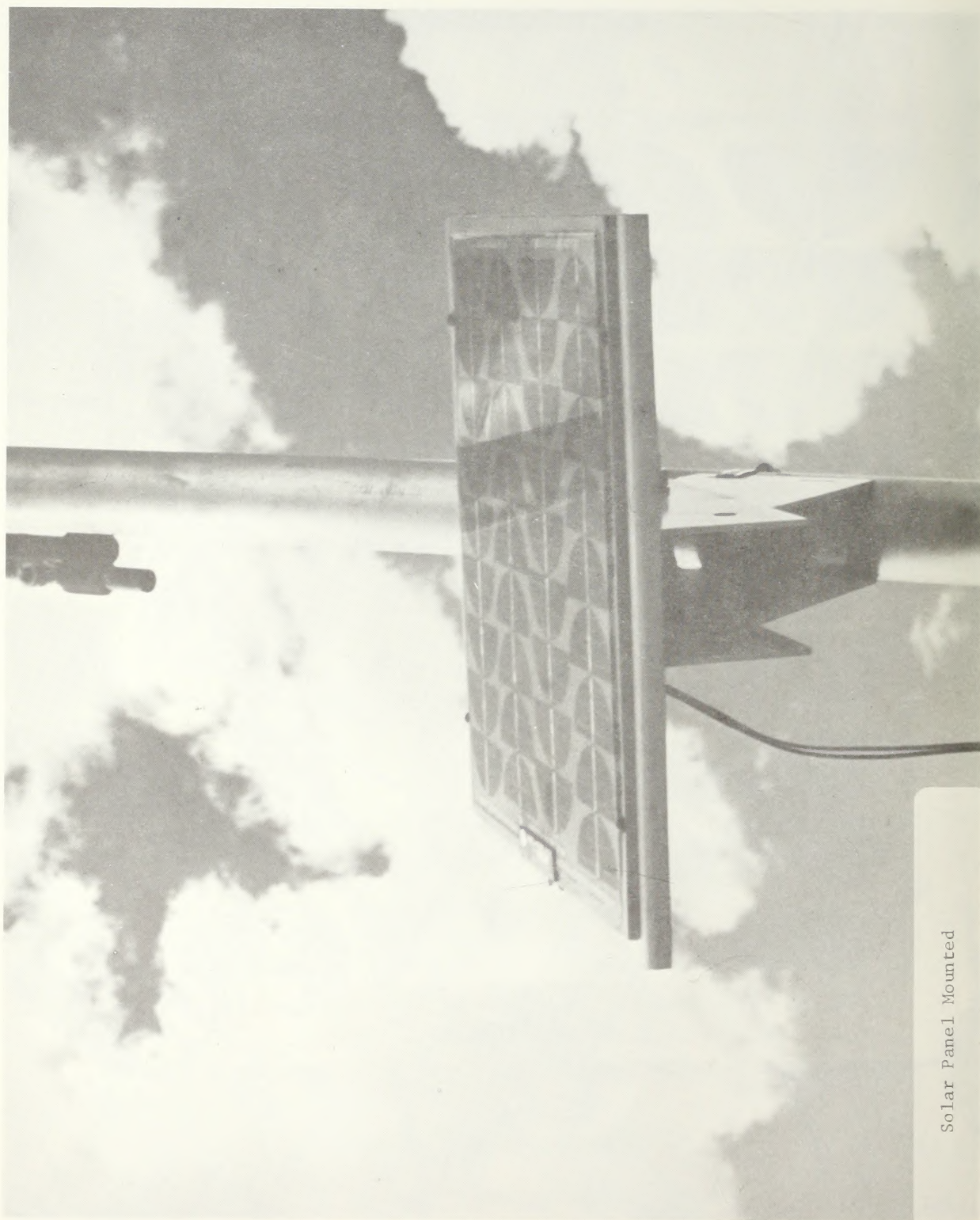
Tipping Bucket Rain Guage



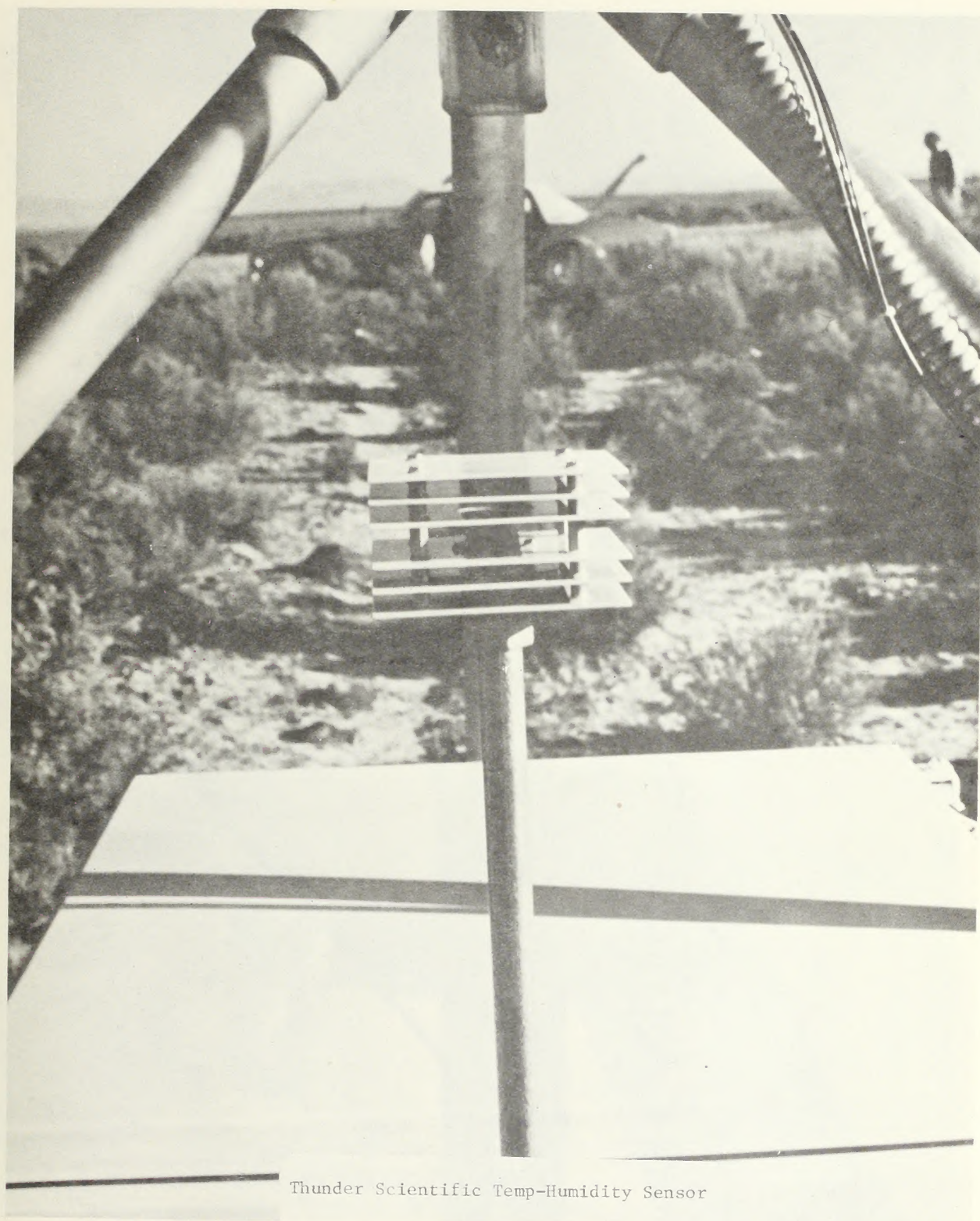
Inside Tipping Bucket Rain Gauge



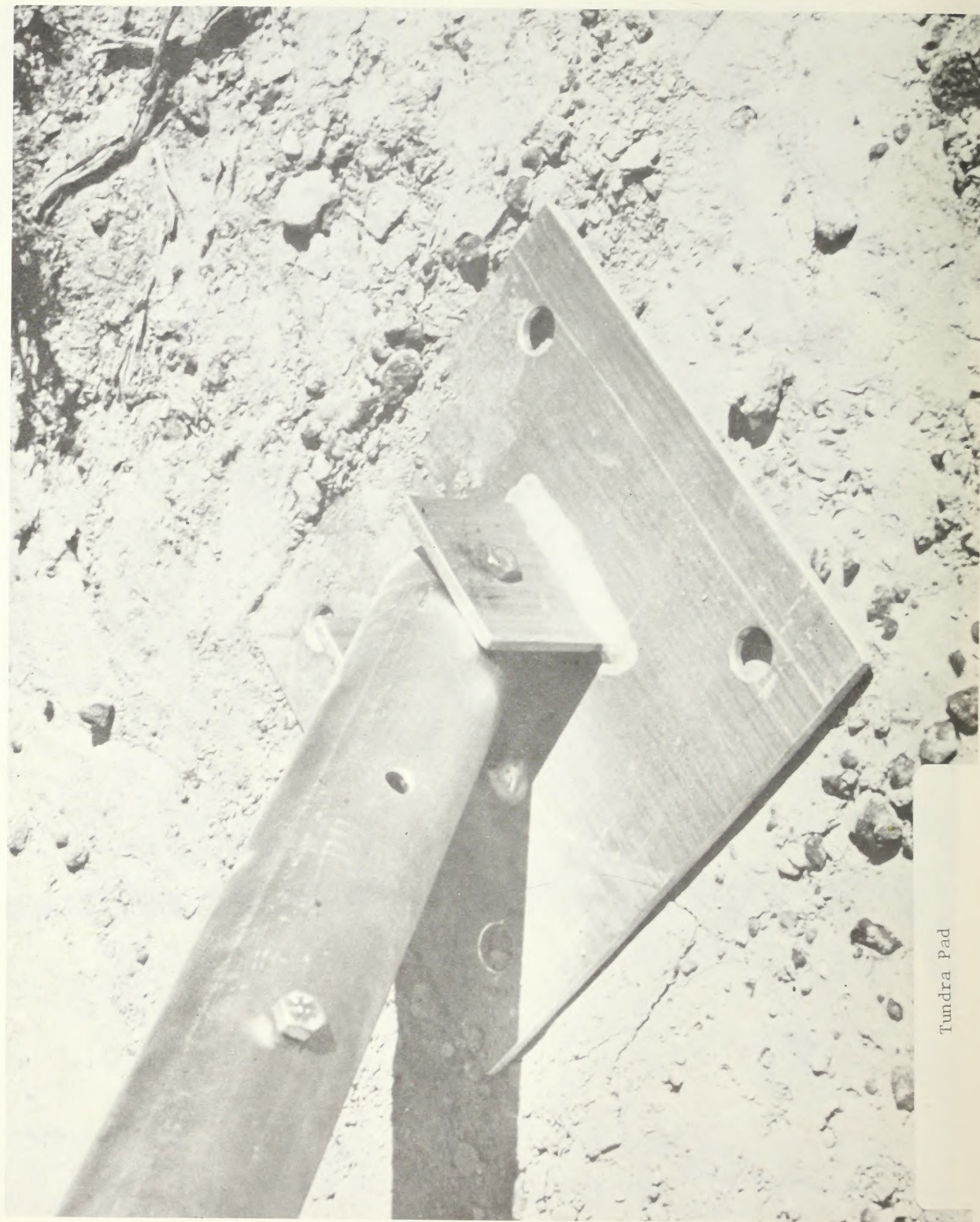
3.5 Watt Solar Panel



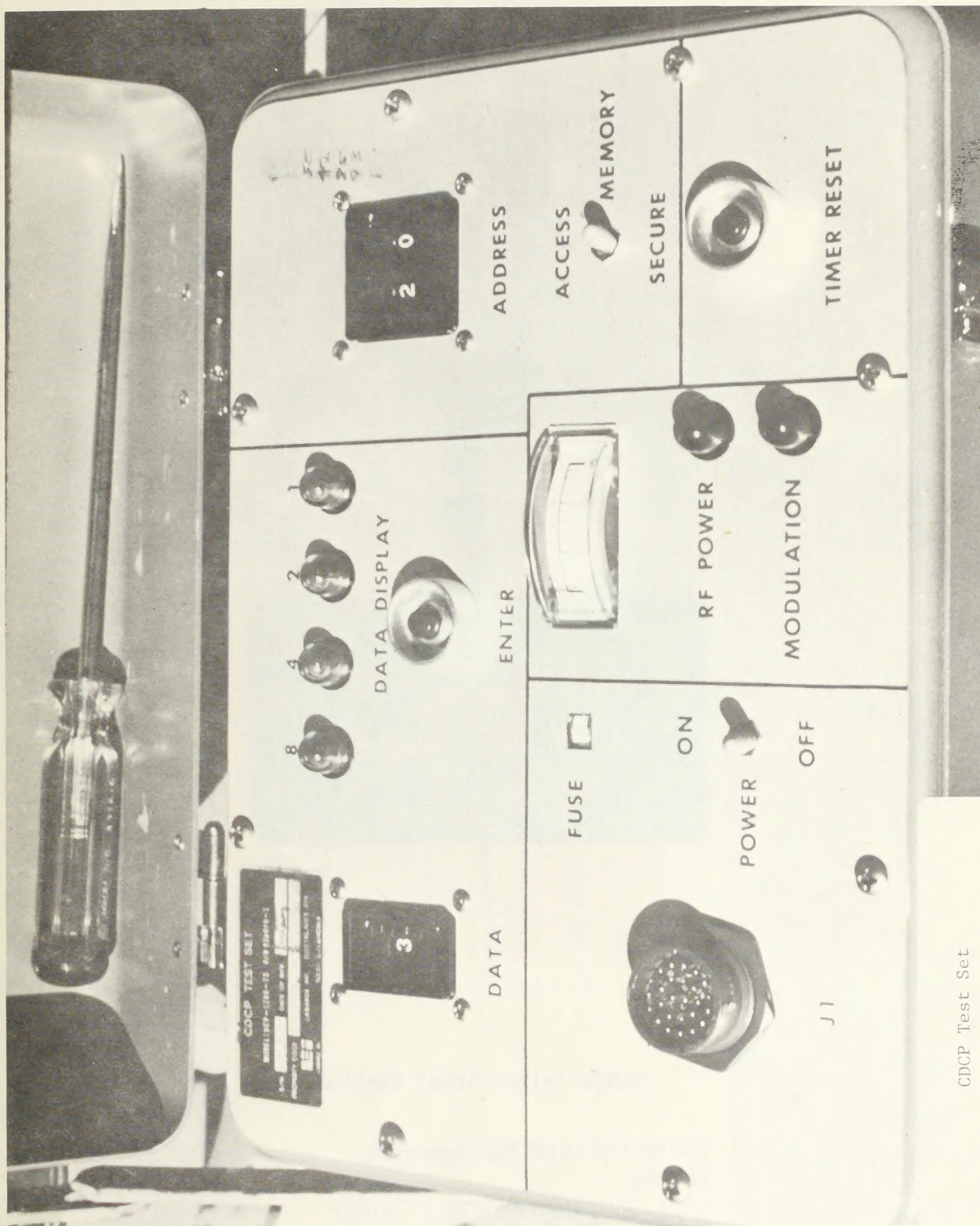
Solar Panel Mounted



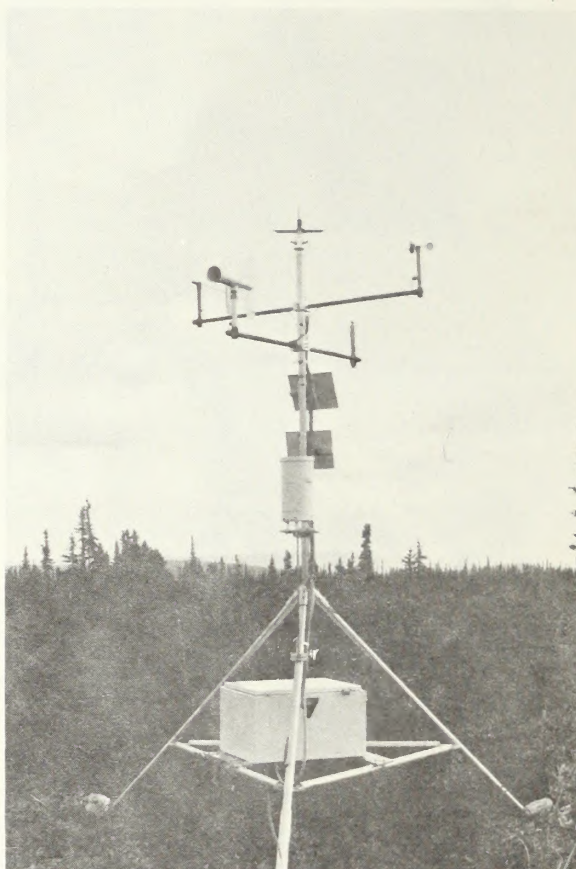
Thunder Scientific Temp-Humidity Sensor



Tundra Pad



CDCP Test Set



BLM's Salmon-Trout Station

Bureau of Land Management
Library
Bldg. 50, Denver Federal Center
Denver, CO 80225

Bureau of Land Management
Library
Denver Service Center

Bureau of Land Management
Library
Bldg. 50, Denver Federal Center
Denver, CO 80225

Borrower's C	
Automatic weather sta	
QC	
876	
. V22	
Date Loaned	Borrower

